DRAFT SYSTEM
TECHNICAL REQUIREMENTS DOCUMENT

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)
PROGRAM DEFINITION AND RISK REDUCTION PROGRAM

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TECHNICAL REQUIREMENTS DOCUMENT
FOR THE
NATIONAL POLAR-ORBITING OPERATIONAL
ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)

CONTRACT NO.

PREPARED FOR:
NPOESS - INTEGRATED PROGRAM OFFICE
SILVER SPRING, MD

PREPARED BY:

Authenticated by____________________ Approved by____________________
Date____________________ Date_________________

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1. SCOPE

1.1 IDENTIFICATION

This Technical Requirements Document sets forth the requirements of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and is hereinafter referred to as the System.

1.2 SYSTEM OVERVIEW

The purpose of the System is to collect global multispectral radiometry and other specialized meteorological, oceanographic, and solar-geophysical data and to disseminate these data to the system's central users and field users deployed worldwide. These data are processed and delivered to the users in the form of Raw Data Records (RDRs), Sensor Data Records (SDRs), and Environmental Data Records (EDRs).

1.3 DOCUMENT OVERVIEW

This document contains all performance and support requirements for the System. In addition, all inter-segment and external interfaces are defined for the System. To avoid duplication, requirements that normally would appear in both 3.2 System Characteristics and 3.7 Segment Characteristics are only stated in section 3.7.

The documentation listed in section 2.0 follows an approach of minimum specs and standards. It is expected to be the basis of a system specification to be proposed by the contractor. The contractor may add to or revise the documents listed in section 2.0 with approval from the government.

The term *"TBD"* applied to a missing requirement means that the contractor should determine the missing requirement in coordination with the government. The term *"TBS"* means that the government will clarify or supply the missing information in the course of the contract. The term *"TBR"* means that the requirement may be reviewed for appropriateness by the contractor or the government and may be changed by the government in the course of the contract.

Appendix A contains a definition of the terms used throughout the document. Appendix B contains the NPOESS survivability requirements which are classified and available in the NPOESS contractor libraries. Appendix C contains SDR requirements including potential sounder/imager frequency ranges that will be displayed as SDR imagery for operational weather forecasting *(TBD)*. Appendix D contains the specific EDR requirements. Appendix E contains the RDRs and EDRs required for each Central and Field Terminal (*TBR*). Appendix F defines the acronyms and abbreviations used throughout the document. Appendix G describes additional NPOESS mission needs which have potentially restrictive technical or programmatic uncertainties and which are beyond the current NPOESS baseline requirements.

1.3.1 Precedence

1.3.1.1 Requirement Weighting Factors

The requirements stated in this specification are not of equal importance or weight. The weighting factors that are incorporated in this specification are specified below.

a. ***Shall*** designates the most important weighting level; i.e. mandatory. Any deviations from these contractually imposed mandatory requirements require the approval of the contracting officer.

b. **S*hould*** designates requirements requested by the government and are not mandatory. Unless required by other contract provisions, noncompliance with the *should* requirements does not require approval of the contracting officer.

c. ***Will*** designates the lowest weighting level. These *will* requirements designate the intent of the government and are often stated as examples of acceptable designs, items and practices. Unless required by other contract provisions, noncompliance with the *will* requirements does not require approval of the contracting officer and does not require documented technical substantiation.

1.3.1.2 Conflicts

TRD 1.3.1.2-1
In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered the superseding requirements, unless the conflict involves the Sensor Requirements Documents (SRDs), the Interface Requirements Document (IRD), or external interface requirements of the System.

TRD1.3.1.2-2
In the event of a conflict involving the Sensor Requirements Documents, the Interface Requirements Document, or the external interface requirements of the System, such as a conflict with equipment external to the System being specified, or in the event of any other unresolved conflict, such as a conflict with government furnished property, the contracting officer shall be notified, and the order of precedence will be as directed by the contracting officer.

1.4 SYSTEM CLASSIFICATIONS

The operational capability of this System is to be implemented incrementally such that the System can transition without major disruption through the following baseline classifications:

a. IOC System (initial operational capability system)
b. FOC System (full operational capability system)

The requirements stated in this document that are not identified as applying to a specific system classification apply to all of the system classifications. Requirements stated as applying to the initial operational capability system also apply to the full operational capability system, unless stated otherwise in the text.

2. APPLICABLE DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

The following documents of the exact issue shown form a part of this TRD to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, see Section 1.3.1. Tailoring of documents in this section is permissible subject to government approval.

SPECIFICATIONS:

Military

DOD-E-83578A May 96	Explosive Ordnance for Space Vehicles, General Specification for
Mil-A-83577B Feb 88	Moving Mechanical Assemblies for Space Launch Vehicles

STANDARDS:

Military

DOD 5200.28-STD Mar 88	Department of Defense Trusted Computer System Evaluation Criteria
MIL-STD-461D Jun 97	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference
MIL-STD-1540C Sep 94	Test Requirements for Launch, Upper Stage, and Space Vehicles
MIL-STD-1541A Dec 87	Electromagnetic Compatibility Requirements for Space Systems

OTHER PUBLICATIONS:

Regulations

AFM-91-201002 7 Oct 94	Explosives Safety Standards
EWR 127-1 31 Mar 95	Eastern and Western Range Safety Requirements
USSPACECOM Reg 57-2, 6 Jun 91	Minimization and Mitigation of Space Debris

Other

ESD-TR-91-212 October 1991	TAF Unit-Level Open System Architecture(ULOSA)Specifications
Feb 95	SARSAT S&R Repeater (SARR)
	NPOESS Conical Microwave Imager Suite Sensor Requirement Document (CMIS SRD)
	NPOESS Visible/Infrared Imager Radiometer Suite Sensor Requirements Document (VIIRS SRD)

	NPOESS GPS Occultation Suite Sensor Requirements Document (GPSOS SRD)
	NPOESS Ozone Mapping Profiling Suite Sensor Requirements Document (OMPS SRD)
	NPOESS Space Environmental Suite Sensor Requirements Document (SES SRD) *(TBS)*

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specified acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 NONGOVERNMENT DOCUMENTS

The following documents of the exact issue shown form a part of this TRD to the Extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, see Section 1.3.1. Tailoring of documents in this section is permissible subject to government approval.

STANDARDS:

ANSI/ISO/TEC 8652 1995	Ada-95 (If Ada is used, then this standard is applicable.)
CCSDS 203.0-B-1 Jan 87	CCSDS Recommendations for Space Data System Standards. Telecommand, Part 3: Data Management Service, Architectural Definition, Blue Book. Issue 1 (Also adopted as ISO/DIS 12174)
CCSDS 701.0 B-2 Nov 92	CCSDS Recommendations for Space Data System Standards for Advanced Orbiting Systems, Network and Data Links: Architectural Specification. Blue Book. Issue 2. (Also adopted as ISO/FDIS 13420)
CCSDS-SCPS *(TBS)*	CCSDS-Space Communications Protocol Specification
National Aerospace Standard 411 Rev 2, 29 Apr 94	Hazardous Materials Management Program

2.3 REFERENCE DOCUMENTS

The following documents are for reference only and do not form a part of this specification. They are listed here because they have been referred to in various parts of the TRD.

SPECIFICATIONS:

<u>Military</u>

AF TM- 86-01	Technical Manual Contract Requirements

STANDARDS:

Military

MIL-STD-129M 1 Jun 93 Notice 115 Sep 89	Marking for Shipment and Storage
MIL-STD-961D 22 Aug 95	DoD Standard Practice for Defense Specifications w/Notice 1

MIL-STD-882c Jan 93	System Safety Program Requirements
MIL-STD-1246C 11 April 94	Military Standard Product Cleanliness Levels and Contamination Control Program
MIL-STD-1472D 14 Mar 89	Human Engineering Criteria for Military Systems, Equipment and Facilities
MIL-STD-1522A May 84 Notice 2: 20 Nov 86; Notice 3: 4 Sep 92	Standard General Requirements for Safe Design and Operation of Pressurized Missile and Space Systems
MIL-STD-1542B Nov 91	Electromagnetic Compatibility (EMC) and Grounding Requirements for Space Systems Facilities
MIL-STD-1543B Oct 88	Reliability Program Requirements for Space and Missile Systems
MIL-STD-1547B Dec 92	Parts and Materials Program for Space and Launch Vehicles
MIL-STD-1809 Feb 91	(USAF): Space Environments for USAF Space Vehicles
MIL-STD-1815	ADA Programming Language

<u>Department of Commerce</u>

September 1995 Edition	National Telecommunications and Information Administration "Manual of Regulations and Procedures for Federal Radio Frequency Management"

<u>NOAA</u>

S24.801 Nov 72	Preparation of Operations and Maintenance Manuals, Revised Apr 97
S24.804 22 Jan 73	General Requirements for Training on Electronic Equipment, Revision One 08/04/87
S24.806 Jan 86	Software Development, Maintenance, and User Documentation, Revised Apr 94
S24.809 1 Dec 89	Grounding Standards

<u>NASA</u>

SP-R-0 022A (JSC) 9 Sept 74	General Specification, Vacuum Stability Requirements of Polymeric Material for Spacecraft Application
NASA Tech Memo 100471	Orbital Debris Environments for Spacecraft Designed to Operate in Low Earth Orbit
NASA SP-8031 1969	NASA Space Vehicle Design Criteria / Structures

PPL-21 March 1995 Updated May 1996	Preferred Parts List PPL-21, Goddard Space Flight Center

OTHER

EIA/IEEE J-STD-016 30 Sep 95	Standard for Information Technology, Software Life Cycle Processes, Software Development, Acquirer-Supplier Agreement

OTHER PUBLICATIONS:

Handbooks

MIL-HDBK-263B 31 July 94	Electrostatic Discharge Control Handbook for Protection of Electrical and Electronic Parts. Assemblies and Equipment (Excluding Electrically initiated Explosive Devices) (Metric)
AFM 15-111 1 Sep 96	Surface Weather Observations
FMH 1B	Federal Meteorological Handbook 1B (Note that AFM 15-111 implements FMH-1 and supercedes FMH-1B and AFM 15-111 Volumes 1&2, which were AF extensions FMH-1.)
MIL-HDBK-340 1 July 1985	Application Guidelines for MIL-STD-1540B: Test Requirements for Space Vehicles
MIL-I-46058	Insulating Compound. Electrical (for Coating Printed Circuit Assemblies)
1985	Handbook of Geophysics and Space Environments

Other

NACSEM 5112(S) Apr 75	Non Stop Evaluation Techniques (U)
2 Nov 89	National Space Policy Directive 1
NSTISSI 7000(S/NF) 17 Oct 88	TEMPEST Countermeasures for U.S. Facilities (U)
1 Jul 1988	SARSAT agreement, for search and rescue (i.e., emergency transmitter locations).
4 Aug 1995	Air Force Satellite Control Network (AFSCN) Operational Requirements Document (ORD)
NAIC-1571-0110-96(S) Mar 96	Defense Meteorological Satellite Program (DMSP)/National Polar-Orbiting Operational Satellite System (NPOESS) System Threat Assessment Report (STAR)
	NPOESS System Protection Guide *(TBS)*
NAIC-1571-727-95 (S/NF/FRD) 11 Sep 1995	Space Systems Threat Environment Description (TED)

2 Aug 1995	Training System Requirements Analysis Book
(TBS)	Guidance for Software Reuse for the NPOESS Program *(TBS)*
26 May 98 Version 2.0	Department of Defense (DoD) Joint Technical Architecture (JTA) Joint Interoperability and Warrior Support

(Technical society and technical association specifications and standards generally are available from reference libraries. They also are distributed among technical groups and using federal agencies. The contracting officer should be contacted regarding the availability of any referenced document not readily available from other sources.)

3. SYSTEM REQUIREMENTS

3.1 DEFINITION

3.1.1 System Description

The NPOESS is a System of polar orbiting weather satellites and ground equipment used for the collection, analysis, and dissemination of weather data to government and civilian users. The System shares data with the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). The role of EUMETSAT Meteorological Operational Program (METOP) in NPOESS is *(TBS)* pending an international agreement between the United States Government (USG) and the European Space Agency (ESA).

3.1.2 System Segments

The System has four system segments:

a. Space Segment (SS)
b. Command, Control, and Communications Segment (C3S)
c. Interface Data Processor Segment (IDPS)
d. Launch Support Segment (LSS)

3.1.2.1 Space Segment (SS) Description

The SS consists of satellites and ground support equipment. The satellites collect global multispectral data on clouds and other meteorological, oceanographic, climatological, and solar-geophysical parameters. The satellites also carry surface data collection (SDC) sensors (e.g., Argos or its follow-on) and search and rescue (S&R) sensors (e.g. Search and Rescue Satellite Aided Tracking (SARSAT)). The satellites store and downlink all data (except S&R) to ground stations, possibly through data relay satellites, and provide a continuous real-time downlink for receipt of data by field terminals within view of the satellite.

3.1.2.2 Command, Control and Communications (C3) Segment Description

The C3S consists of shared and dedicated resources: ground stations which provide ground to space connectivity, primary and backup satellite operations centers, communication elements, and flight vehicle simulators. The C3 functions include Mission Planning, Antenna Resource Scheduling, Satellite Operations, Anomaly Resolution, System Security, Relay of Data to Central Users, and Spacecraft and Sensor Engineering support of activities such as launch and early-orbit checkout.

3.1.2.2.1 Ground Station Element

Ground stations provide ground to space connectivity for the C3S. They are shared assets and may include NOAA's Command and Data Acquisition (CDA) ground stations at Fairbanks, Alaska, and Wallops Island, Virginia, the AFSCN Remote Tracking Stations (RTS) located at Thule, Greenland; Oakhanger, England; and/or others including commercial command data acqusition stations (*TBD)*. The European command data acquisition stations at Kiruna, Sweden or Tromso, Norway may be utilized to augment capabilities, but a back up capability must exist such that NPOESS requirements are able to be met without that augmentation.. NPOESS equipment at a ground station form an element of the C3S. Other ground stations (e.g., Antarctica station or NASA's Tracking and Data Relay Satellite System (TDRSS) stations) may be considered to improve timeliness.

3.1.2.2.2 Satellite Operations Center (SOC)

The primary SOC will be located at Suitland, MD and the backup SOC will be at Schriever AFB, CO, unless the use commercial satellite operations center(s) is determined to be more cost effective. The primary SOC will be responsible for performing the operational functions of satellite command and control, mission planning, antenna resource scheduling, launch and early orbit support, anomaly resolution, telemetry data processing, and the support of data delivery to users . The backup SOC will be capable of performing the same operational functions as the primary SOC, with the exception that launch and early orbit operations will only be done from the primary SOC. The back up SOC, if located at Schriever AFB, CO, will be operated by the USAF Reserves.

3.1.2.2.3 Data Routing and Retrieval (DRR)

The DRR will provide all inter-segment communications for the C3S and IDPS. Inter-segment communications include the routing of stored mission data to the IDPS Central element and all telemetry (stored and real-time) data to the SOCs in support of System data availability requirements. (DRR does not provide space-ground communications) The DRR will provide routing for commands, and any other communications between the SOCs, Ground stations, Flight Vehicle Simulators (FVS), and IDPS elements.

3.1.2.2.4 Flight Vehicle Simulator (FVS)

The FVS element will provide high fidelity simulation of the on-orbit spacecraft and sensors. An operator console will monitor and control the health and welfare of simulated satellites.

3.1.2.3 Interface Data Processor Segment (IDPS) Description

The IDPS consists of ground hardware and software elements which ingest and store (temporarily) the Raw Data Records (RDRs) and process them, as necessary, into Sensor Data Records (SDRs) and Environmental Data Records (EDRs) at Centrals and at DoD Field Terminals. The currently defined Centrals are AFWA, NOAA/NESDIS, FNMOC, NAVOCEANO, and 55SWXS. Field Terminals may be land or ship-based, fixed or mobile, and they may receive real-time mission data directly downlinked from the spacecraft. The NOAA/NESDIS IDPS will receive and store (temporarily) RDRs, and make available in unprocessed form to NOAA/NESDIS data processing facilities.

3.1.2.4 Launch Support Segment (LSS) Description

The LSS will provide resources to accomplish launch operations, and to place each satellite into the correct orbit. The LSS includes all launch support equipment including Aerospace Ground Equipment (AGE), Real Property Installed Equipment (RPIE) and launch facilities. AGE consists of test equipment, computer check-out systems, etc. RPIE includes items such as power equipment, air conditioning equipment, and non-flight fuel stores. The launch facilities include payload test facilities and other required equipment/facilities to support ground operations for testing the satellite following integration onto the launch vehicle. A listing of launch site processing facilities for pre-launch checkout and servicing of the satellite is *(TBS)*.

3.1.3 A Partial Specification Tree.

The partial specification tree for the System is shown in Figure 3-1 (*TBR*).

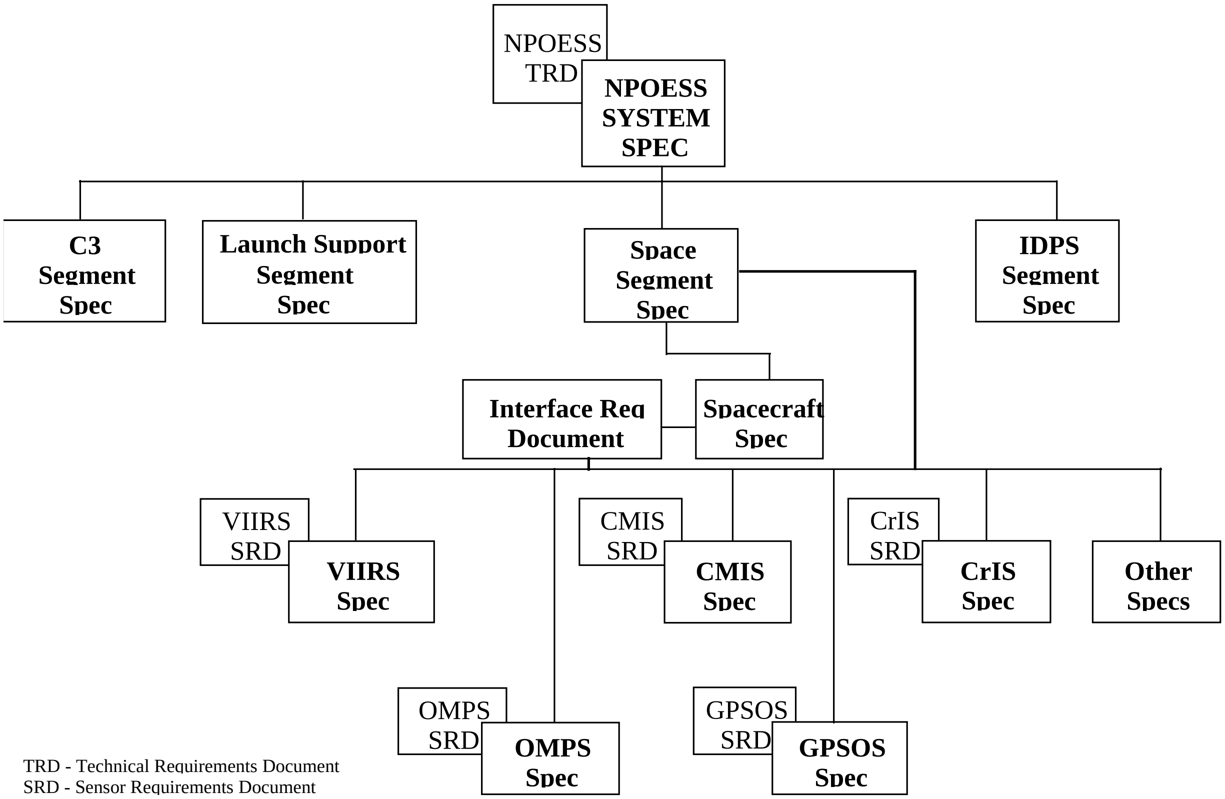


Figure 3-1 Partial System Specification Tree (*TBR*).

3.1.4 Top-Level System Functions *(TBS)*

3.1.5 System Modes

At the system level there are three modes of operation: [1] Normal Operations Mode; [2] Data Encryption Mode; and [3] System Upgrade Mode. In the Normal Operations Mode, individual segments can be in various segment modes. In the Data Encryption Mode, the System will have the capability to automatically encrypt all links, except for the S&R and SDC real time downlinks. In the System Upgrade Mode, the System will support Normal Operations plus all activities involved with a given system upgrade. An example of a system upgrade is the launch and on-orbit check out of a new satellite.

3.1.6 Operational and Organizational Concept

3.1.6.1 Expendable Launch Vehicle Concept

Each satellite will be launched using an expendable launch vehicle with a goal of direct insertion into the operational orbit. The NPOESS baseline is planned to be a medium class launch vehicle..

3.1.6.2 Launch Operations Concept

3.1.6.2.1 Pre Launch

The satellite will be transported directly to the launch base where final vehicle preparations and checkout will be accomplished. Final inter-segment and launch system verification tests will be accomplished prior to launch.

3.1.6.2.2 Launch and Injection

During launch and injection to the operational orbit, the various spacecraft subsystems may be powered on or turned off in order to provide protection from the launch and injection environments or to comply with other specified requirements. Spacecraft telemetry to monitor vehicle status will be provided during launch and injection. Transmission of launch vehicle telemetry may satisfy this requirement during the launch phase. Spacecraft telemetry transmission to ground monitoring stations will be used to the extent practicable during the injection phase. After insertion into its operational orbit and separation from the launch vehicle, appropriate deployments would be initiated by memory command. Early orbit check-out will be conducted at the NPOESS primary SOC.

3.1.6.3 On-orbit Operational Concept

3.1.6.3.1 On-orbit Tests

The initial on-orbit period is devoted to a complete spacecraft checkout and the calibration and performance verifications of the sensor(s). The spacecraft and sensor performance verification tests may be repeated at appropriate times during the operational phase of the mission.

3.1.6.3.2 Initial and Full Operational Capabilities

The System initial operational capability (IOC) will be met when: two satellites *(TBR)* are operational; sufficient C3 and mission data recovery resources are available to allow all mission data to be processed at all centrals and 50 percent of the field terminals; sufficient crews are trained to allow 24 hours/day, 365 days/year operations at the primary SOC, and to allow backup operations as needed; sufficient sustaining engineering resources are in place to allow for anomaly resolution, for example; sufficient logistics resources are in place to support C3, data recovery, and the IDPS; and approval to operate at Schriever AFB is received. The System full operational capability (FOC) will be met when: a full NPOESS satellite constellation meeting all contractual system requirements is operational; sufficient C3 and mission data recovery resources are available; sufficient crews are trained; sufficient logistics resources are in place to support C3S, data recovery, and IDPS operations; and approval to operate at Schriever AFB is received.

3.1.6.3.3 On-orbit Operations

3.1.6.3.3.1 Space Segment

The satellites continuously perform required measurements using the on-board sensors and support the SDC and S&R sensors. Real-time data are continuously broadcast so that users within the field of view may receive the data. The satellites receive commands from the ground for either execution in real time or for subsequent on-board execution.

3.1.6.3.3.2 C3 Segment

The C3S will route data to the Centrals' IDP. The C3S should be able to also receive and route data from an NPOESS-dedicated EUMETSAT METOP (*TBR*) and route NPOESS data received by METOP ground stations. Routing of NPOESS data to EUMETSAT facilities is ***(TBS).***

Satellite Control Authority (SCA) is the authority to direct, approve, or delegate satellite command and control. This authority will reside with the primary SOC. The backup SOC will assume SCA in the event of a failure at the primary SOC, or during any other scenario as directed by the IPO (e.g., preventive maintenance activities).

3.1.6.3.3.2.1 Ground Stations

The ground stations will provide the space-to-ground connectivity for the System. Mission data, as well as stored and real-time telemetry data will be downlinked to the ground stations from the satellite. The downlinked data will be stored at the ground stations as well as relayed to the data routing and retrieval element for distribution. The ground stations will also provide the capability for uplink commanding.

3.1.6.3.3.3 IDP Segment

Elements of the IDP segment will receive RDRs and process them as appropriate for their missions into EDRs. The IDP segment may also use ancillary data in the processing. Processing RDRs into EDRs will require production of intermediate-level satellite sensor data files, commonly known as Sensor Data Records (SDRs) and Temperature Data Records (TDRs). SDRs/TDRs associated with imagery and sounding EDRs are used for near term display, for retrospective processing to develop improved processing methods, or for archival to support long-term sensor evaluation or troubleshooting. This data is also vital when validating the data, determining data quality, and in data quality resolution. SDR intermediate-level data needs to be available as separate and selectable data records for user displays. Availability of TDRs or other intermediate level data is *(TBD).*   Throughout this document, production of EDRs will necessarily also mean production of intermediate-level processed data files, as needed. This includes the EDR/RDR matrix (Appendix E), which lists delivery destinations of RDRs/EDRs. See Appendix A for definition of terms.

3.1.7 Missions

The mission of the System is to provide an enduring and survivable capability which supports user requirements through all levels of conflict consistent with the survivability of the supported forces, to collect and disseminate global meteorological, oceanographic, and solar-geophysical data required to support worldwide DoD and civilian operations and high-priority programs. An auxiliary mission is to provide S&R capabilities.

3.1.8 Threat

The System is subject to the threat described in Section 6.

3.2 SYSTEM CHARACTERISTICS

Requirements that are known to be applicable only to a single segment or to a single prime Configuration Item (CI), such as the spacecraft, are stated in the appropriate paragraph in Subsection 3.7 and not in this subsection.

3.2.1 Performance Characteristics

3.2.1.1 Performance Requirements for Each System Mode

TRD3.2.1.1-1
The System/and or satellite shall be able to separately command any sensor suite into any sensor mode.

TRD3.2.1.1-2
In all modes, the System shall provide RDRs, SDRs, and EDRs to the users.

TRD3.2.1.1-3
In the Data Encryption Mode, the System shall have the capability to deny any or all links, except for the S&R and SDC real time downlinks.

TRD3.2.1.1-4
In the System Upgrade Mode, the System shall support Normal Operations plus all activities involved with a given system upgrade.

3.2.1.2 Data Availability

3.2.1.2.1 Data Availability to the Centrals

The percentage of time for preemption of NPOESS data downlink by a higher priority mission in a system that utilizes government resources is *(TBD).*

TRD3.2.1.2.1-1
The mission data shall be provided to the Centrals as shown in Appendix E.

TRD3.2.1.2.1-2
The mission data acquired and stored by a satellite shall be downloaded via the C3S at least once per orbit.

TRD3.2.1.2.1-3
Direct downlink of stored data from the satellite is not required at the centrals, however a minimum of two Centrals shall receive all the stored data via the C3S in order to provide for backup and contingencies. This requirement does not apply in the case of a real-time data relay solution (e.g. TDRSS) or for direct fiber optic links between ground stations and Centrals.

TRD3.2.1.2.1-4
Ninety-seven point five percent (97.5%) (on an annualized basis) of the observable data collected shall be provided to the Centrals.

TRD3.2.1.2.1-5
Ninety-five percent (95%) of the time, the elapsed time from the time of observation until all of the required EDRs have been processed at the Centrals shall be no greater than 1.25 times the length of an orbital period plus 30 minutes.

TRD3.2.1.2.1-6
In the case of a missed pass, the maximum elapsed time shall be no greater than 2.5 times the orbital period plus the 30 minute period mentioned above.

TRD3.2.1.2.1-7
Data (RDR to EDR) processing time at DoD Centrals shall not exceed 20 minutes. This 20 minute period shall be part of the 30 minute period described above.

TRD3.2.1.2.1-8
If a satellite contact is missed, data shall be stored and recovered on the next available contact.

TRD3.2.1.2.1-9
The spacecraft shall be able to store at least one and a quarter orbits of data *(TBR)* at the regional (high) resolution for those EDR parameters with a regional horizontal spatial resolution (or cell size) specified in Appendix D.

TRD3.2.1.2.1-10
Specific areas for acquisition of regional data for each orbit might not be contiguous, but shall be commandable.

TRD3.2.1.2.1-11
The spacecraft shall also be able to store at least two and a half orbits of data *(TBR)* at global resolution.

3.2.1.2.1.1 NOAA/NESDIS

TRD3.2.1.2.1.1-1
NOAA/NESDIS shall receive the stored RDR data set from any NPOESS satellite within 15 minutes of loss of signal (LOS) *(TBR)* at any NPOESS C3 station. A RDR data set is defined as beginning at LOS from one C3 station to the next LOS of the next C3 station. (The RDR data set will then include observations being acquired by the NPOESS satellite during acquisition at any C3S station).

3.2.1.2.2 General Data Availability to Field Terminals

The Field Terminals are comprised of two types: high data rate (HRD) and low data rate (LRD). NPOESS shall provide *(TBS)* HRD units and *(TBS)* LRD units to the US military. NPOESS is not responsible for modifications to non-DoD field terminals. Lossy compression is allowed in both the high*(TBR)* and low real-time data rate links.

TRD3.2.1.2.2-1
Real-time mission data shall be provided directly to field users whenever the NPOESS satellite is within the field of view of the field terminal and above the signal horizon.

TRD3.2.1.2.2-2
The NPOESS system shall provide for modification of the DoD field terminals, if required, to receive and process the mission data from the NPOESS satellite with no degradation in existing capabilities.

3.2.1.2.3 High Data Rate DoD Terminals

TRD3.2.1.2.3-1
The high data rate Field Terminal IDPS shall receive the high resolution data stream containing the mission data as specified in Appendix E.

3.2.1.2.4 Low Data Rate DoD Terminals

TRD3.2.1.2.4-1
If required, the low data rate Field Terminal IDPS shall receive the low data rate link (e.g. fewer channels at regional resolution or all channels at reduced resolution) containing the mission data as specified in Appendix E incorporating lossy compression techniques *(TBR)*.

3.2.1.3 Autonomous Mode Capability

Each satellite should be capable of performing housekeeping tasks without ground contact.

TRD3.2.1.3-1
The satellite shall have an autonomous mode capability which maintains the ability to provide real-time mission data with a mapping accuracy threshold of at least 45 km (≤ 1 km objective) without C3 contact for a period of at least 21 days (60 days objective) providing that the satellite was operating normally prior to switching to autonomous mode.

TRD3.2.1.3-2
The System shall automatically deny all links, except for the S&R and SDC real time downlinks, providing that the satellite was operating normally prior to switching to autonomous mode.

TRD3.2.1.3-3
Storing of sensor data and transfer of stored data to ground receivers may be affected, but real-time transmissions shall not be affected by autonomous mode.

TRD3.2.1.3-4
Each satellite shall automatically transition to autonomous operations after an SCA determined and table loaded (e.g. 24 hours default) period of time has elapsed from the time of reception of the last command from the C3S.

TRD3.2.1.3-5
Each satellite shall maintain a historical record of autonomous events to the extent necessary to enable reconstruction of the decisions made and methods used by the satellite while performing autonomous mode.

TRD3.2.1.3-6
Each satellite shall be commandable between normal operations and autonomous mode by reception of a correct ground command from the C3S.

TRD3.2.1.3-7
Ground control override by the C3S shall be provided for any autonomous function.

TRD3.2.1.3-8
The spacecraft shall recover to normal operations within 5 minutes after reconfiguration commands from the ground.

3.2.1.4 Orbit Adjustment Capability

TRD3.2.1.4-1
The System shall maintain a precise orbit altitude to +/- 17 *(TBR)* km, ± 0.05 *(TBR)* degrees inclination, and nodal crossing times to +/- 10 minutes while in normal operational mode throughout the mission lifetime.

TRD3.2.1.4-2
The System shall maintain an exact groundtrack repeat to +/- 1 km over *(TBD)* days.

TRD3.2.1.4-3
The System shall provide the same satellite functional capabilities after an orbit adjustment maneuver as were available prior to the maneuver if they cannot be maintained during the maneuver.

TRD3.2.1.4-4
Each NPOESS satellite shall be designed to prevent damage or contamination of on-board sensors and subsystems due to delta-V thrust applications during an orbit adjustment maneuver.

3.2.1.5 Surface Data Collection

TRD3.2.1.5-1
The SDC sensor, with the exception of the antennas, will be provided GFE, and shall be integrated, operated, and maintained.

TRD3.2.1.5-2
The System shall transmit SDC data in real-time for reception by worldwide civilian field terminals.

TRD3.2.1.5-3
The System shall store SDC data for subsequent transmittal to Centrals.

TRD3.2.1.5-4
The System shall be capable of acquiring data from the uplinks of up to a total of 5600 (*TBR*) Platform Transmitter Terminals (PTTs) with up to 1660 (*TBR*) PTTs within each satellite's instantaneous field of view.

3.2.1.6 Search and Rescue (S&R) Capability

TRD3.2.1.6-1
The S&R sensor, with the exception of the antennas, will be provided GFE and shall be integrated, operated, and maintained.

TRD3.2.1.6-2
Data from the S&R sensor shall be downlinked to the S&R Mission Control Centers (MCCs) and Local User Terminals (LUTs) in real time.

3.2.1.7 Mission Planning Capability

TRD3.2.1.7-1
The System shall perform the mission planning required to prioritize user requests, schedule the required use of the ground station network, distribute mission, SDC, S&R, and telemetry data, provide pass plans to users, and coordinate mission events with European agencies, as required.

3.2.1.8 Mission Sensor Calibration

TRD3.2.1.8-1
The System shall perform periodic autonomous or ground controlled mission sensor calibration as required.

3.2.1.9 Data Access

Mission data access is a key parameter. Mission data and telemetry (stored and real time) are denied only when the System is in autonomous mode, or when the National Command Authority directs NPOESS to go into system encryption mode in times of national emergency (see 3.3.9.1.1.1 Data Deniability.)

TRD3.2.1.9-1
Under normal conditions, NPOESS unencrypted mission data and telemetry (stored and real time) shall be accessible by users on a world-wide basis.

TRD3.2.1.9-2
The System shall always provide an unencrypted real-time SDC data downlink.

TRD3.2.1.9-3
The System shall always provide an unencrypted S&R data downlink.

3.2.1.10 Real-time Data Downlink Transmission Capability

TRD3.2.1.10-1
NPOESS satellites shall have the capability to continuously downlink real-time mission data to field terminals at both a high data rate and a low data rate simultaneously.

TRD3.2.1.10-2
The high data rate link shall contain mission data at the same resolution as that for regional resolution provided to Centrals.

TRD3.2.1.10-3
The low data rate link shall contain fewer channels of mission data and/or a coarser resolution than the high data rate link.

3.2.1.10.1 Real-time Telemetry Downlink Transmission Capability

TRD3.2.1.10.1-1
NPOESS satellites shall have the capability to downlink real-time telemetry data when each satellite is in contact with a C3S ground station.

3.2.1.11 Stored Data Downlink Transmission Capability

TRD3.2.1.11-1
NPOESS satellites shall have the capability to downlink data that have been acquired and stored onboard the satellite to the C3 Segment while the satellite is in contact with a C3 Segment ground station.

TRD3.2.1.11-2
This downlink shall include mission data, SDC, and health and status telemetry data.

3.2.1.12 Data Time Synchronization

TRD3.2.1.12-1
All RDRs shall contain time reference information for data synchronization supported by GPS or equivalent.

3.2.1.13 Data Formatting and Compression

TRD3.2.1.13-1
The System shall conform to the Consultive Committee for Space Data Systems (CCSDS) packetization per the *(TBS)* real-time interface specification and the *(TBS)* stored-data interface specification.

TRD3.2.1.13-2
If data compression techniques are used in stored data retrieval, the compression shall be lossless.

TRD3.2.1.13-3
If data compression techniques are used in real time, the compression may be lossy *(TBR)*.

TRD3.2.1.13-4
Each CCSDS header shall contain the NPOESS flight vehicle number, instrument type, time tag (accurate to 1.0 microsecond), and ephemeris data (accurate to better that 100 meters in each radial component).

3.2.1.14 Command and Memory Loads Uplink Transmission

TRD3.2.1.14-1
The System shall have the capability of transmitting information to the satellite onboard processors. This information includes operational parameters, processor instructions (software) and sequencing states.

3.2.1.15 Satellite External and Built-in Testing

TRD3.2.1.15-1
The System shall have the capability of externally testing each satellite, while in storage and on the launch pad, to verify its performance and operational readiness. Components that must be cold to operate properly are not subject to external testing on the launch pad.

TRD3.2.1.15-2
Each satellite shall have the capability of accomplishing self-testing using built-in test (BIT) functions to determine its functionality, performance, and operational readiness.

3.2.2 System Capability Relationships

3.2.2.1 Reference Timelines

(TBS)

3.2.3 Interface Requirements

NPOESS external and internal interfaces are illustrated in Fig. 3.2.3-1.

3.2.3.1 External Interface Requirements

The following subparagraphs describe the requirements for interfaces between NPOESS and other systems.

3.2.3.1.1 External Interface to Central User

TRD3.2.3.1.1-1
The IDPS element shall interface with its host facility for floor space, power, lighting, air-conditioning, security, and access to communications networks.

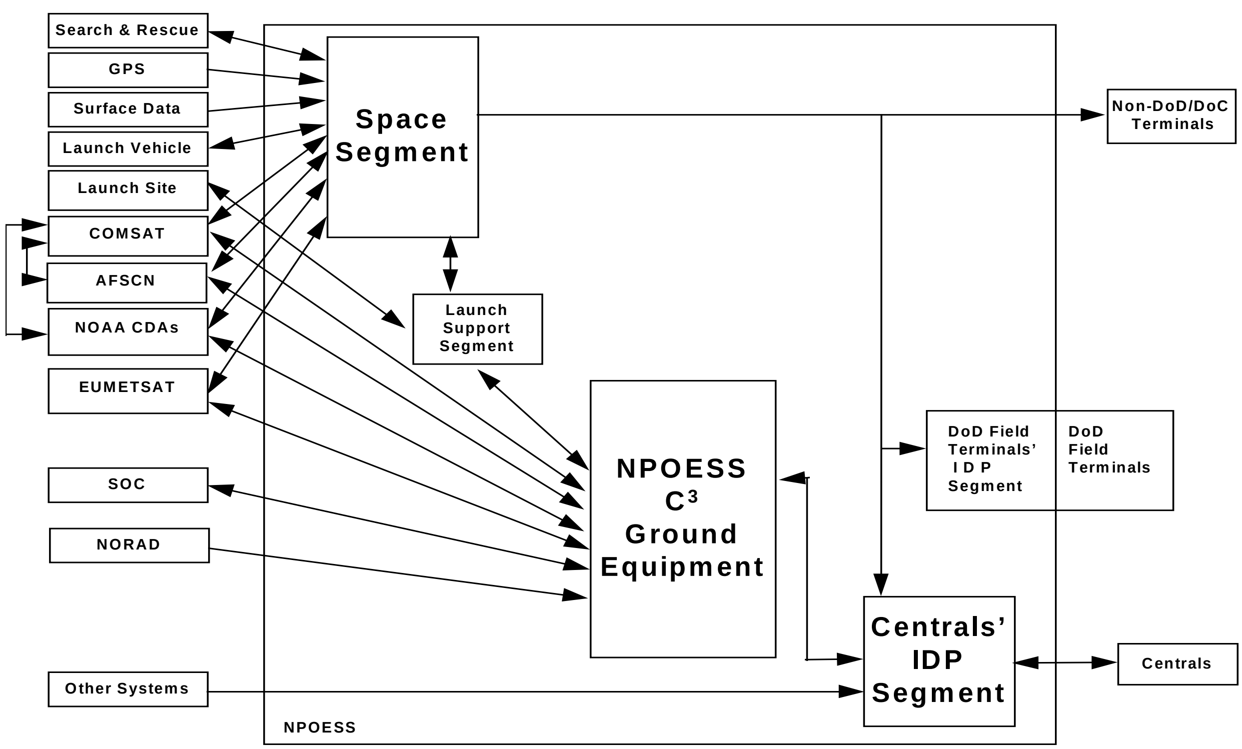
TRD3.2.3.1.1-2
Backup power sources shall be able to provide power for 24 hours *(TBR)*.

TRD3.2.3.1.1-3
The IDPS element shall have the capability to provide RDRs, SDRs, TDRs *(TBR)* and EDRs to Centrals as specified in Appendix E.

TRD3.2.3.1.1-4
The IDPS element shall have the capability to respond to data requests from Centrals within 24 hours.

TRD3.2.3.1.1-5
The IDPS element shall have the capability to receive ancillary data as required to generate the EDRs specified in Appendix E *(TBR).*

TRD3.2.3.1.1.-6
The IDPS element shall have the capability to provide SDC data.



Note: Some external systems will contain NPOESS equipment. These systems may include the SOC, AFSCN, NOAA CDAs, Field Users, and METOP.

Figure 3.2.3-1. NPOESS External and Internal Interfaces

3.2.3.1.2 External Interface to DoD Field Terminal

The NPOESS Field Terminal external interfaces will consist of the interface between the NPOESS-modified DoD field terminal (receiver equipment and IDPS) and the unmodified field terminal equipment (network computer terminals, display monitors, and servers hosting data bases of ancillary data received independently of NPOESS (e.g. AFWA model outputs, terrain etc.)).

TRD3.2.3.1.2-1
The IDPS field element shall provide the capability to deliver EDRs as specified in Appendix E to the Field User.

TRD3.2.3.1.2-2
The IDPS shall have the capability of receiving ancillary data as needed for EDR generation.

TRD3.2.3.1.2-3
The IDPS generated data base(s) shall have the capability to respond to data requests from field terminals for a period of time corresponding to the respective IDPS storage capabilities.

3.2.3.1.2.1 External Interfaces to Receiver Equipment *(TBR)*

This external interface applies only to existing, unmodified receiver equipment; if NPOESS modifies or provides new DoD field terminal receiver equipment because existing receivers cannot accommodate the NPOESS data stream, then the interface to the new or modified equipment is internal.

TRD3.2.3.1.2.1-1
The IDPS field terminal element shall have the capability to receive real-time mission data from the field terminal receiver equipment.

3.2.3.1.3 External Interface to Non-DOD Field Terminals

TRD3.2.3.1.3-1
The Space Segment shall continuously downlink real-time mission data and SDC data to Non-DoD field terminals.

3.2.3.1.4 External Interface to Other Field Terminals

(TBS)

3.2.3.1.5 External Interface to METOP Spacecraft

(TBD)

3.2.3.1.6 External Interface to Search and Rescue System

The NPOESS Space Segment will incorporate a S&R sensor which is provided GFE (with the exception of the antennas). The S&R sensor receives uplink signals at 121.5, 243.0, and 406.05 MHz from emergency location transmitters (ELT). The transmissions at 406.05 MHz are processed by the sensor's Search and Rescue Processor (SARP), which measures the frequency and extracts the transmitted message, then stores this information together with the time of reception in the SARP-M circular memory. This stored information is then retrieved in near real-time and formed into the SARP 2.4 kbps data stream. The SARP data stream is interleaved with the translated outputs from receivers at 121.5 and 243.0 MHz, and a separate receiver centered at 406.05 MHz, and downlinked in real-time at 1544.5 MHz to any S&R emergency location transmitter (ELT) within the satellite's field of view (see SARSAT S&R Repeater (SARR). Then these data are forwarded to the S&R Mission Control Centers. These centers distribute the data to the international search and rescue forces. The S&R system is part of the COSPAS-SARSAT international search and rescue system which is managed by representatives of the U.S., Canada, France, and Russia. The S&R ELTs and LUTs will be supplied, implemented, operated, and maintained by local authorities.

The NPOESS Program will be compatible with DOC's international agreements, COSPAS / SARSAT agreement, 1 Jul 1988) for search and rescue (i.e., emergency transmitter locations).

TRD3.2.3.1.6-1
The Space Segment shall be capable of receiving ELT data and downlinking the data at 1544.5 MHz to any S&R LUTs within the satellite's field of view. Data formats are (*TBS*).

TRD3.2.3.1.6-2
The Space Segment shall not alter the data that is transmitted between the S&R sensor and a S&R LUT to prevent interference or unauthorized contact.

3.2.3.1.7 External Interface to Surface Data Collection

The NPOESS Space Segment will incorporate a SDC sensor (e.g., Argos) which is provided GFE (with the exception of the antennas). The sensor receives randomly distributed uplink signals at 401.650MHz from Argos PTT deployed on a worldwide basis. The transmissions are processed by the sensor and downlinked over the satellite's SDC real-time data downlinks to any Argos Local User Terminals within the satellite's field of view. The stored Argos data is downlinked as part of the stored data downlink to the C3S for subsequent transmission via the central site at NOAA/NESDIS to the Argos processing centers in the U.S. and France. The Argos system is an international surface data collection system which is managed by France.

TRD3.2.3.1.7-1
The Space Segment shall be capable of receiving Argos (or follow-on) Platform data and downlinking the data in real-time to any Argos LUTs or follow-on SDC terminals in the field. The data is also stored onboard for transmission to centrals.

TRD3.2.3.1.7-2
Command formats shall be (*TBS*).

3.2.3.1.8 External Interface to Launch Vehicle

The LSS should be coordinated with the Launch Vehicle (LV) contractor for scheduling, status, and launch support at the launch base.

TRD3.2.3.1.8-1
During the pre-separation phase the System shall provide positive inhibits for execution of any stored program commands which have safety implications.

TRD3.2.3.1.8-2
The NPOESS satellite shall be compatible with the physical, mechanical, electrical, and environmental interfaces with the LV, its payload attach fitting, and its payload fairing in accordance with the LV contractor's payload planners guide.

TRD3.2.3.1.8-3
The NPOESS satellite shall not exceed a "medium class" launch vehicle capability such as EELV.

3.2.3.1.9 External Interface to WTR/Launch Site

The LSS should be coordinated with the appropriate US Government personnel to arrange for the use of the launch facilities and their equipment for satellite processing.

TRD3.2.3.1.9-1
The LSS shall interface with the Western Test Range and launch control facilities for launch operations.

TRD3.2.3.1.9-2
The extent of the interface with the WTR shall be to verify compliance with the applicable Range Safety Requirements of EWR 127-1, including ground monitoring functions.

3.2.3.1.10 External Interface to NORAD

TRD3.2.3.1.10-1
After the launch of NPOESS satellites, the System shall support requests to NORAD (*TBR*) and receipt from NORAD (*TBR*) of ELSETs for orbit determination whenever any satellite's own orbit determination capability is not operational.

3.2.3.1.11 External Interface to SOC's Host Facility

The NPOESS primary and backup SOCs will interface with their host facilities and with the ESA's SOC.

3.2.3.1.11.1 External Interface to Primary SOC's Host Facility

TRD3.2.3.1.11.1-1
The NPOESS primary SOC shall define the interface with its host facility for floor space, power, lighting, air-conditioning, security, and access to communications networks.

3.2.3.1.11.2 External Interface to Backup SOC

TRD3.2.3.1.11.2-1
The NPOESS backup SOC shall interface with its host facility for floor space, power, lighting, air-conditioning, security, and access to communications networks.

3.2.3.1.11.3 External Interface to ESA SOC

TRD3.2.3.1.11.3-1
The NPOESS primary SOC shall interface with the ESA SOC for coordination and scheduling of METOP ground stations for communications with NPOESS satellites.

TRD3.2.3.1.11.3-2
The NPOESS primary SOC shall interface with the ESA SOC to coordinate operations of the METOP satellites and the transmission of METOP data to the centrals.

TRD3.2.3.1.11.3-3
When in primary control of the NPOESS constellation, the NPOESS backup SOC shall interface with the ESA SOC for scheduling of METOP ground stations for communications with NPOESS satellites.

TRD3.2.3.1.11.3-4
When in primary control of the NPOESS constellation, the NPOESS backup SOC shall interface with the ESA SOC to coordinate operations of the METOP satellite and the transmission of the data to the centrals.

TRD3.2.3.1.11.3-5
The backup SOC shall interface with the ESA SOC to coordinate operations of the NPOESS satellites and the transmission of data to the centrals.

3.2.3.1.12 External Interface to Shared Resources

Depending on the C3 concept, the System will interface on a shared basis with AFSCN RTSs, NOAA CDAs, METOP ground stations, commercial data acquisition sites and/or TDRSS.

3.2.3.1.12.1 External Interface to AFSCN RTS *(TBR)*

TRD3.2.3.1.12.1-1
NPOESS Space Segment and/or C^3 equipment shall interface with shared resources at applicable AFSCN stations.

TRD3.2.3.1.12.1-2
The C^3 Segment shall have the capability to interface with the 21st and 22nd Space Operations Squadrons for the purpose of scheduling AFSCN RTS(s) to provide NPOESS satellite contacts when needed.

3.2.3.1.12.2 External Interface to NOAA CDAs *(TBR)*

TRD3.2.3.1.12.2-1
NPOESS Space Segment and/or C^3 equipment shall interface with shared resources at applicable NOAA CDAs.

3.2.3.1.12.3 External Interface to METOP Ground Stations *(TBR)*

TRD3.2.3.1.12.3-1
NPOESS Space Segment and/or C^3 equipment shall interface with shared resources at applicable METOP ground stations.

3.2.3.1.12.4 External Interface to Commercial Command Data Acquisition Stations *(TBR)*

TRD3.2.3.1.12.4-1
NPOESS Space Segment and/or C^3 equipment shall interface with shared resources at applicable commercial command data acquisition sites.

3.2.3.1.12.5 External Interface to TDRSS

(TBD)

3.2.3.1.13 External Interface to Data Routing and Retrieval

TRD3.2.3.1.13-1
All NPOESS C2 links shall comply with national and international guidelines (National Telecommunications and Information Administration (NTIA) and International Telecommunications Union (ITU)) for spectrum utilization/sharing.

TRD3.2.3.1.13-2
The DRR element of the C3 segment shall be structured to receive sufficient simultaneous links from the ground stations to meet timeliness requirements.

3.2.3.1.14 FVS External Interface to Host Facility

TRD3.2.3.1.14-1
Each FVS shall interface with its host facility for floor space, power, lighting, air conditioning, security, and access to communications network.

3.2.3.2 Inter-Segment Interface Requirements

The following subparagraphs describe the requirements for the interfaces between the NPOESS segments.

3.2.3.2.1 Space Segment to DoD Field Terminal (Interface Data Processor Segment)

The System will provide two real-time mission data downlinks per satellite between the satellites and the Field Terminal Element of the IDPS: a high data rate downlink and a low data rate downlink.

TRD3.2.3.2.1-1
The communication links between the SS and the DoD Field Terminal element shall provide the capability to prevent intentional interference to the data. Specific requirements are defined in the classified attachment to this TRD.

TRD3.2.3.2.1-2
The communication links between the SS and the DoD Field Terminal element shall provide the capability to prevent unintentional interference to the data.

TRD3.2.3.2.1-3
The data format for the communication links between the SS and the DoD Field Terminal element shall be the Consultative Committee for Space Data Systems (CCSDS) format for Advanced Orbiting Systems, Networks and Data Links: Architectural Specification", CCSDS Recommendation 701.0-B-1.

TRD3.2.3.2.1-4
The bit error rate shall be less than or equal to 1.0 E-06 *(TBR)*. For transmission of encrypted data, the bit error rate applies to transmission from the output of the encryptor to the input of the decryptor.

3.2.3.2.1.1 High Data Rate Downlink Interface

TRD3.2.3.2.1.1-1
The operational frequency band for the high data rate downlink shall be *(TBD)*.

TRD3.2.3.2.1.1-2
The bandwidth for the high data rate downlink shall be *(TBD)* MHz.

TRD3.2.3.2.1.1-3
The data rate shall be less than 13.0 Mbps *(TBR)*.

TRD3.2.3.2.1.1-4
The modulation and coding for the high data rate downlink shall be *(TBD)*.

TRD3.2.3.2.1.1-5
The Effective Isotropic Radiated Power (EIRP) for the high data rate downlink shall be *(TBD)* dBm.

TRD3.2.3.2.1.1-6
The polarization for the high data rate downlink shall be *(TBD)*.

TRD3.2.3.2.1.1-7
The high data rate downlink shall continuously transmit (excluding downtime to switchover to backup systems in the event of transmitter failure) the mission data for reception by high data rate terminals.

TRD3.2.3.2.1.1-8
The HRD DoD user terminal shall have a receive aperture of less than 2.0 meters *(TBR)*.

3.2.3.2.1.2 Low Data Rate Downlink Interface

TRD3.2.3.2.1.2-1
The operational frequency for the low data rate downlink shall be *(TBD)* MHz.

TRD3.2.3.2.1.2-2
The bandwidth for the low data rate downlink shall be *(TBD)* MHz.

TRD3.2.3.2.1.2-3
The data rate shall be less than 100 Kbps *(TBR)*.

TRD3.2.3.2.1.2-4
The modulation and coding for the low data rate downlink shall be *(TBD)*.

TRD3.2.3.2.1.2-5
The EIRP for the low data rate downlink shall be *(TBD)* dBm.

TRD3.2.3.2.1.2-6
The polarization for the low data rate downlink shall be *(TBD)*.

TRD3.2.3.2.1.2-7
The low data rate downlink shall continuously transmit (excluding downtime to switchover to backup systems in the event of transmitter failure) the mission data for reception by low data rate terminals.

TRD3.2.3.2.1.2-8
The receiver aperture shall not exceed 2.0 meters *(TBR)*.

3.2.3.2.2 Space Segment to/from C3 Segment

The Space Segment will provide three types of RF links to the C3 Segment: a stored mission data downlink, a command uplink, and a real-time telemetry downlink.

TRD3.2.3.2.2-1
The SS shall have the capability to downlink stored mission data and telemetry to the C3 Segment.

TRD3.2.3.2.2-2
The SS shall have the capability to receive commands and memory uploads from the C3 Segment.

TRD3.2.3.2.2-3
The SS shall have the capability to downlink real-time telemetry to C3 Segment.

TRD3.2.3.2.2-4
All links between the C3 Segment and the Space Segment shall provide the capability to preclude unauthorized contact.

TRD3.2.3.2.2-5
The bit error rate shall be less than or equal to 1.0 E-06*(TBR)*. For transmission of encrypted data, the bit error rate applies to transmission from the output of the encryptor to the input of the decryptor).

TRD3.2.3.2.2-6
The data format for the communication links between the Space Segment and the C3 Segment shall be the Consultative Committee for Space Data Systems (CCSDS) format for “Advanced Orbiting Systems, Networks and Data Links: Architectural Specification”, CCSDS Recommendation 701.0-B-1.

TRD3.2.3.2.2-7
The C3 segment shall have the capability of receiving selected sensor data from METOP satellites. TT&C support to METOP spacecraft is *(TBS)* in accordance with international agreement.

3.2.3.2.2.1 Stored Mission Data Downlink Interface

TRD3.2.3.2.2.1-1
The operational frequency band for the stored mission data downlink shall be *(TBD)*.

TRD3.2.3.2.2.1-2
The bandwidth for the stored mission data downlink shall be *(TBD)*.

TRD3.2.3.2.2.1-3
The data rate for the stored mission data downlink shall be less than 300.0 *(TBR)* Mbps.

TRD3.2.3.2.2.1-4
The modulation and coding for the stored mission data downlink shall be *(TBD)*.

TRD3.2.3.2.2.1-5
The EIRP for the stored mission data downlink shall be *(TBD)* dBm.

TRD3.2.3.2.2.1-6
The polarization for the stored mission data downlink shall be *(TBD)*.

TRD3.2.3.2.2.1-7
The ground receiver aperture shall not exceed 13 meters, with a strong preference to keep the aperture below 8.0 meters *(TBR)*.

3.2.3.2.2.2 Command Uplink Interface

TRD3.2.3.2.2.2-1
The operational frequency band for the command uplink shall be *(TBD)*.

TRD3.2.3.2.2.2-2
The bandwidth for the command uplink shall be *(TBD).*

TRD3.2.3.2.2.2-3
The data rate for the command uplink shall be less than 112.0*(TBR)* kbps.

TRD3.2.3.2.2.2-4
The modulation and coding for the command uplink shall be *(TBD)*.

TRD3.2.3.2.2.2-5
The EIRP for the command uplink shall be *(TBD)* dBm.

TRD3.2.3.2.2.2-6
The polarization for the command uplink shall be *(TBD).*

*TRD*3.2.3.2.2.2-7
The Space Segment shall be commandable in any orientation of the spacecraft to include tumbling conditions.

TRD3.2.3.2.2.2-8
The ground transmit aperture shall not exceed 13 meters *(TBR)*.

3.2.3.2.2.3 Real-time Telemetry Downlink Interface

TRD3.2.3.2.2.3-1
The operational frequency band for the real-time telemetry downlink shall be *(TBD)*.

TRD3.2.3.2.2.3-2
The bandwidth for the real-time telemetry downlink shall be *(TBD)* MHz.

TRD3.2.3.2.2.3-3
The data rate for the real-time telemetry downlink shall be less than 112.0 *(TBR)* kbps.

TRD3.2.3.2.2.3-4
The modulation and coding for the real-time telemetry downlink shall be *(TBD)*.

TRD3.2.3.2.2.3-5
The EIRP for the real-time telemetry downlink shall be *(TBD)* dBm.

TRD3.2.3.2.2.3-6
The polarization for the real-time telemetry downlink shall be *(TBD).*

*TRD*3.2.3.2.2.3-7
The Space Segment shall be able to transmit real-time telemetry in any spacecraft orientation including a tumbling state.

TRD3.2.3.2.2.3-8
The ground receive aperture shall not exceed 10 meters *(TBR).*

3.2.3.2.3 C3 Segment to Central Element of the Interface Data Processor Segment

TRD3.2.3.2.3-1
The C3 Segment shall interface with the Central Element of the IDPS via high speed data lines with the capacity to handle simultaneous spacecraft transmissions to meet EDR timeliness and early orbit requirements.

3.2.3.2.4 C3 Segment to Launch Support Segment

TRD3.2.3.2.4-1
The LSS shall provide the C3S with the capability to perform required C3 operations during pre-launch operations.

3.2.3.2.5 Space Segment to Launch Support Segment

TRD3.2.3.2.5-1
The LSS shall provide the capability to interface with the satellite to support battery conditioning during pre-launch.

TRD3.2.3.2.5-2
The LSS shall provide the capability to command and monitor the health and status of the satellite via the launch umbilical during launch operations until the moment of launch.

TRD3.2.3.2.5-3
The LSS shall support access to the satellite for launch processing, servicing, and maintenance.

TRD3.2.3.2.5-4
The LSS shall ensure that a launch base processing environment is provided which is within the design limits of the satellite.

3.2.3.3 Infrastructure Support and Interoperability

The NPOESS should be designed to be interoperable and compatible with existing systems. Interoperability means computer systems provided by NPOESS should be able to function with host system architectures existing at the time.

TRD3.2.3.3-1
The NPOESS implementation shall not impact the operational capabilities of existing user systems (DoD/DOC Central and DoD field elements).

3.2.3.3.1 Transportation and Basing

TRD3.2.3.3.1-1
The NPOESS field terminals shall meet *(TBS)* transportation and basing requirements.

3.2.3.3.2 Standardization, Interoperability, and Commonality

The NPOESS C3 Segment should maximize compatibility with existing systems. The NPOESS C3 segment software should be written in a computer language which is compatible with the future equipment selected for the DOC and DoD sites *(TBS).* The software should be interoperable between agencies systems. The NPOESS should comply with appropriate information technology standards (DoD/DOC) applicable at the time of IOC to the extent possible.

TRD3.2.3.3.2-1
The Interface Data Processor Segment for field terminals shall support open systems architectures per ULOSA standards.

3.2.4 Physical Characteristics

3.2.4.1 Mass Properties

TRD3.2.4.1-1
The mass properties of each NPOESS satellite and its associated flight equipment shall meet the requirements of the Launch Vehicle (LV) with no less than a 2% (*TBR*) margin at the final weighing before shipment to the launch facility.

3.2.4.2 Dimensions

TRD3.2.4.2-1
All measurement units within the System shall be in the International System of Units (SI), unless off-the-shelf hardware precludes this, in which case a waiver demonstrating cost savings is required.

TRD3.2.4.2-2
The dimensional envelope constraints of the size and shape of the NPOESS satellite shall be based upon a combination of static, dynamic, and thermal conditions encountered during factory assembly, system test, transportation and handling, launch, deployment, and on-orbit operations.

TRD3.2.4.2-3
The satellite or sensor configuration shall prevent any unwanted solar reflections from interfering with environmental data collection.

TRD3.2.4.2-4
The dimensional envelope constraints of the size and shape of the ground-based NPOESS elements shall be based upon a combination of building and transportation constraints during the mission.

3.2.4.3 Power

3.2.4.3.1 Satellite Internal Power

High power spacecraft components should be designed to operate from a 28 volt dc power subsystem.

TRD3.2.4.3.1-1
Primary power distribution to low power components shall be compatible with system and subsystem EMC performance requirements.

TRD3.2.4.3.1-2
Secondary power distribution to low power components shall be compatible with system and subsystem EMC performance requirements.

3.2.4.3.2 Satellite External Power

Unless otherwise specified, satellites undergoing checkout should be operated from a 28 volt dc, two-wire, single-point negative grounded external power subsystem.

3.2.4.3.3 Wiring

All harnesses should be compatible with the testing and operational environments.

3.2.4.4 Survivability

The NPOESS System Survivability requirements are contained in Appendix B.

3.2.4.4.1 Interface Data Processor Segment NBC Survivability

The Interface Data Processor Segment will be integrated into mobile and fixed systems some of which are required to meet NBC survivability requirements.

TRD3.2.4.4.1-1

The Interface Data Processor Segment DoD Field Terminals shall be operable by the user under NBC conditions with the user wearing NBC clothing.

3.2.4.5 Endurance

TRD3.2.4.5-1
The operational service life of the contractor-furnished ground-based NPOESS elements shall be no less than 10 years past IOC with a continuous operational duty cycle of 24 hours per day and 365 days per year with prescribed maintenance.

TRD3.2.4.5-2
The on-orbit design life of the satellite, as may be limited by factors such as mechanical wearout, battery life, solar array life, or the exhaustion of expendables, shall be no less than 7 years.

TRD3.2.4.5-3
The design of the satellite shall be such that satellite storage, under controlled conditions, may be planned for as long as 8 years, including up to 3 years for intermittent testing.

TRD3.2.4.5-4
The design service life of the satellite shall be at least 15 years. This includes the time allowed for test, storage, prelaunch checkout, launch and injection, on-orbit, recovery, and contingency.

3.2.4.6 Protective Coatings

TRD3.2.4.6-1
The finishes used shall ensure that the completed devices are resistant to corrosion caused by environmental conditions and galvanic action.

TRD3.2.4.6-2
The SS of the NPOESS shall have special coatings for protection of surfaces against deterioration in space environments.

TRD3.2.4.6-3
The SS of the NPOESS shall have special coatings for electrostatic discharge suppression in all environments.

TRD3.2.4.6-4
The SS of the NPOESS shall not use cadmium or zinc platings.

TRD 3.2.4.6-5
Pure tin or tin alloy (>98% Sn) plating shall not be used on electrical devices and hardware for launch and space vehicles. The guiding document for this prohibition is MIL-STD-1547B, "Electronic Parts, Materials, and Processes for Space and Launch Vehicles."

TRD3.2.4.6-6
Both metallic and insulating surfaces in electronic boxes, such as printed wiring assemblies, where contamination could cause electrical malfunction shall be conformally coated unless otherwise insulated or hermetically sealed. The use of conformal coatings applies to electrical components in launch and space vehicles and their associated ground equipment. MIL-I-46058, or equivalent can be used in selection of conformal coatings and their thickness. Unjacketed, flexible shielded cable and ground straps are specifically excluded from this conformal coating requirement.

TRD3.2.4.6-7
Certain components will suffer significant performance degradation if conformally coated. In these situations, non-use of conformal coatings on electrical components and hardware shall be supported by a thorough analysis and be specifically approved by the government on a case by case basis.

3.2.5 System Quality Factors

3.2.5.1 System Operational Availability

System Operational Availability (A_O) is defined as the probability that a system is operable and ready to perform its mission at any given time. A_O is a function of mean time between critical failure (MTBCF) and mean time to restore functions (MTTRF) and is calculated as:

$$Ao = \frac{\text{MTBCF}}{\text{MTBCF} + \text{MTTRF}}$$

where:

$$\text{MTBCF} = \frac{\text{operating time}}{\text{number of critical failures}}$$

and:

$$\text{MTTRF} = \frac{\text{total time down from critical failures}}{\text{number of critical failures}}$$

TRD3.2.5.1-1
The A_O of the NPOESS System shall be greater than *(TBD)*.

3.2.5.2 Space Segment

TRD3.2.5.2-1
The space segment shall be operational 24 hours per day with no on-orbit repair capability.

TRD3.2.5.2-2
The NPOESS space segment shall meet an Ao of greater than 95.00%. Reliability of METOP satellites will not be included in space segment availability calculations.

TRD3.2.5.2-3
MTBCF for the space segment shall be no less than *(TBD)* hours.

TRD3.2.5.2-4
MTTRF for the space segment shall not exceed *(TBD)* hours.

TRD3.2.5.2-5
The satellite shall remain in a readiness condition following integration and system performance verification so that it is be available for launch within 60 days (45 days objective). At any time from completing integration and performance verification to the end of the satellite storage period the satellite will support a launch event within 60 days of notification (45 days objective).

3.2.5.2.1 Space Segment Operational Service Life

TRD3.2.5.2.1-1
The NPOESS space segment shall support an operational service life of at least 10 years after IOC.

3.2.5.2.2 Maintainability

The spacecraft design should include maintainability features to ensure timely replacement or test of spacecraft subsystems or sensors prior to launch.

TRD3.2.5.2.2-1
Only remove and replace maintenance actions shall be performed on the satellite after acceptance for shipment or storage by the procuring agency.

TRD3.2.5.2.2-2
Except for software updates, space-based elements of the System shall not require maintenance or repair on-orbit.

TRD3.2.5.2.2-3
Single-point failures of the spacecraft and key sensors shall be eliminated where practical on new or existing designs if they cause critical or catastrophic failures.

TRD3.2.5.2.2-4
Single-point failures of the spacecraft and key sensors shall be eliminated where practical.

TRD3.2.5.2.2-5
For all cases where failure of a redundant element on-orbit would cause loss of mission, a catastrophic or a critical hazard, a capability for automatic switchover to the backup component and/or circuit shall be provided.

3.2.5.3 C3 Segment

The requirements below apply to NPOESS equipment only.

TRD3.2.5.3-1
The A_O of the C3 Segment shall be greater than *(TBD)*.

3.2.5.3.1 Fault Detection

TRD3.2.5.3.1-1
Built-In-Test (BIT)/Built-In-Test-Equipment (BITE) fault detection shall automatically or manually detect not less than 98%, with an objective of 99%, of any single failure down to the line replaceable unit (LRU) without any support equipment.

3.2.5.3.2 Fault Isolation

TRD3.2.5.3.2-1
Built-In-Test (BIT)/Built-In-Test-Equipment (BITE) fault isolation shall automatically or manually identify not less than 98%, with an objective of 99%, of any single failure down to the line replaceable unit (LRU) without any support equipment. The fault isolation should also be operator-initiation capable.

3.2.5.4 IDPS

The requirements below apply to NPOESS equipment only.

TRD3.2.5.4-1
The A_O of the IDPS shall be greater than *(TBD)*.

3.2.5.4.1 Fault Detection

TRD3.2.5.4.1-1
Built-In-Test (BIT)/Built-In-Test-Equipment (BITE) fault detection shall automatically or manually detect not less than 98%, with an objective of 99%, of any single failure down to the line replaceable unit (LRU) without any support equipment.

3.2.5.4.2 Fault Isolation

TRD3.2.5.4.2-1
Built-In-Test (BIT)/Built-In-Test-Equipment (BITE) fault isolation shall automatically or manually identify not less than 98%, with an objective of 99%, of any single failure down to the line replaceable unit (LRU) without any support equipment. The fault isolation should also be operator-initiation capable.

3.2.5.5 Additional Quality Factors

3.2.5.5.1 System Compatibility

NPOESS capabilities should be configured to be compatible, as appropriate, to meet user needs with minimum impact to existing receiver terminals and procedures. In addition to DOC and DOD user requirements, NPOESS capabilities should consider other national and international agencies together with universities/academia and industry.

3.2.5.5.2 Transition

TRD3.2.5.5.2-1
During the transition period, NPOESS shall not interfere with the normal operation of the DMSP and POES Systems, except where shared resource allocation by the Satellite Control Authority results in such interference.

3.2.6 Environmental Conditions

Segment requirements to allow for the adverse impacts of the natural environment should be derived from space segment design life and/or data availability requirements.

3.2.7 Transportability

TRD3.2.7-1
The satellite(s) and the support equipment that must be transported with the satellite shall be designed for ground and air transportation in accordance with best commercial or military practices.

3.2.8 Flexibility and Expansion

System flexibility and expansion should be provided by the System design and architecture.

3.2.8.1 Operational Computer Resource Reserves

A distinction is made between the computer resource reserves required for space segment, for the IDPS, and for the ground elements of the C^3 segment.

TRD3.2.8.1-1
Addition and modification of computer resources in space elements of later flights shall be accommodated by the sensor and spacecraft designs.

TRD3.2.8.1-2
For the IDPS segment and for the ground elements of the C^3 segment, the design and installation of the equipment shall be such that equipment modifications may be readily made after the initial installation to meet the growth requirements.

3.2.8.1.1 Computer Resource Reserves for Operational Space Elements

For the purposes of this specification, the data processing subsystems of the operational space elements are defined to comprise all computer hardware and software, in the satellite(s), including all interfacing space equipment, all NPOESS developed sensors, and single application, embedded firmware-based processors. This excludes non-NPOESS developed sensors such as S&R and SDC. Note, however, that the worst case loading, capacity, throughput, and access rate requirements referred to in this specification include the requirements placed upon the data processing subsystems of the space elements by *all* sensors, launch vehicle, spacecraft, and system interfaces.

TRD3.2.8.1.1-1
The data processing subsystems of the space elements shall have 100 percent growth margin while meeting the original functional and performance computational requirements, including timing. This requirement allows the growth margin to be used if the government adds additional requirements.

3.2.8.1.1.1 Data Processing Subsystems Processor Reserves

TRD3.2.8.1.1.1-1
Within the processing environment of the data processing subsystems of the space elements, each processor shall have an instruction execution rate sufficient to process a workload that is 100 percent greater than the worst case processor utilization workload that could load that processor.

3.2.8.1.1.2 Data Processing Subsystems Primary Memory Reserves

TRD3.2.8.1.1.2-1
Within the environment of the data processing subsystems of the space elements, the primary memory for each processor shall have 100 percent greater memory capacity than the worst case memory size requirement for that primary memory component.

TRD3.2.8.1.1.2-2
Within the environment of the data processing subsystems of the space elements, the primary memory for each processor shall have, or be capable of having, memory added (through modification, addition, or replacement) to attain a 200 percent greater memory capacity than the worst case memory size requirement for that primary memory component.

3.2.8.1.1.3 Data Processing Subsystems Peripheral Data Storage (Secondary Memory) Reserves

TRD3.2.8.1.1.3-1
Within the environment of the data processing subsystems of the space elements, each peripheral data storage (secondary memory) component shall have 100 percent *(TBR)* greater storage capacity than the worst case storage requirement for that peripheral data storage component.

TRD3.2.8.1.1.3-2
Within the environment of the data processing subsystems of the space elements, each peripheral data storage (secondary memory) component shall have, or be capable of having, storage added (through modification, addition, or replacement) to attain, a 200 percent *(TBR)* greater storage capacity than the worst case storage requirement for that peripheral data storage component.

3.2.8.1.1.4 Data Processing Subsystems Data Transmission Media

TRD3.2.8.1.1.4-1
Within the environment of the data processing subsystems of the space elements, each data transmission medium (e.g., local or global bus or channel) shall have sufficient capacity to support data throughput that is 50 percent greater than the worst case data throughput that could load that data transmission medium.

TRD3.2.8.1.1.4-2
Within the environment of the data processing subsystems of the space elements, each data transmission medium (e.g., local or global bus or channel) shall have, or be capable of being augmented (through modification, addition, or replacement) to have, sufficient capacity to support data throughput that is 200 percent greater than the worst case data throughput that could load that data transmission medium.

3.2.8.1.1.5 Data Processing Subsystems Software/Firmware

TRD3.2.8.1.1.5-1
Any hardware augmentations necessary to meet the expansion requirements shall, where practical, be designed so that the software and firmware in the data processing subsystems of the space elements are upward compatible with the implementation of those augmentations.

3.2.8.1.2 Computer Resource Reserves for Operational Ground Equipment

For the purposes of this specification, the operational data processing subsystems of the ground elements of the space system are defined to comprise all computer hardware and software required by the IDPS segment and by the ground elements of the C^3 segment. Reserve requirements to support program expansion in terms of additional use of existing functions are necessary in the ground elements of the operational data processing subsystems of the space system.

TRD3.2.8.1.2-1
The data processing subsystems of the ground elements shall be capable of data throughput that is 100 percent greater than that required to satisfy the worst case data processing requirements that could jointly load the operational ground equipment data processing subsystems of the ground elements.

3.2.8.1.2.1 Data Processing Subsystems Processor Reserves

TRD3.2.8.1.2.1-1
Within the processing environment of the data processing subsystems of the ground elements, each processor shall have an instruction execution rate sufficient to process a workload that is 100 percent greater than the worst case processor utilization workload that could load that processor.

3.2.8.1.2.2 Data Processing Subsystems Primary Memory Reserves

TRD3.2.8.1.2.2-1
Within the environment of the data processing subsystems of the ground elements, the primary memory for each processor shall have 100 percent greater memory capacity than the worst case memory size requirement for that primary memory component, if operating under a non-virtual operating system.

TRD3.2.8.1.2.2-2
If operating under a virtual operating system, the virtual memory capacity for that processor shall provide for 100 percent greater virtual memory capacity than the worst case virtual memory size requirement for that processor.

3.2.8.1.2.3 Data Processing Subsystems Peripheral Data Storage (Secondary Memory) Reserves

TRD3.2.8.1.2.3-1
Within the environment of the data processing subsystems of the ground elements, each peripheral data storage (secondary memory) component shall have 100 percent greater storage capacity than the worst case storage requirement for that peripheral data storage component.

3.2.8.1.2.4 Data Processing Subsystems Data Transmission Media

TRD3.2.8.1.2.4-1
Within the environment of the data processing subsystems of the ground elements, each data transmission medium (e.g., local or global bus or channel) shall have sufficient capacity to support data throughput that is 100 percent greater than the worst case data throughput that could load that data transmission medium.

3.2.8.1.2.5 Data Processing Subsystems Software/Firmware

TRD3.2.8.1.2.5-1
Any hardware augmentations necessary to meet the expansion requirements specified shall, where practical, be designed so that the software and firmware in each data processing subsystem of the ground elements is upward compatible with the implementation of those augmentations.

3.2.8.2 Non-operational Computer Resource Reserves

3.2.8.2.1 Computer Software Maintenance Resources: Additional Growth Capability

TRD3.2.8.2.1-1
The computer resources used for computer software maintenance shall be capable of accommodating the specified growth requirements of the operational computer resources without necessitating any major modifications.

3.2.8.2.2 Computer Resources in Training Equipment: Additional Growth Capability

TRD3.2.8.2.2-1
The training equipment (such as the FVSs) shall be capable of accommodating the growth requirements of the operational computational equipment without necessitating major modifications.

3.2.8.2.3 Network Structure

TRD3.2.8.2.3-1
The ground system architecture shall utilize commercial standard networking methods to interlink processing systems.

TRD3.2.8.2.3-2
The capability of the network shall allow for a system growth of 200% in terms of nodes and total amount of data transmitted on the network.

3.2.9 Portability

The System should be designed for portability of software to other open system architecture equipment. Individual equipment/subsystems and components should be designed to be portable, as necessary.

TRD 3.2.9-1
The application software shall be easily ported to systems.

3.3 DESIGN AND CONSTRUCTION

3.3.1 Materials

TRD3.3.1-1
Unless otherwise specified, the parts, materials, and processes shall be selected and controlled in accordance with contractor documented procedures to satisfy the specified requirements (ref MIL-STD-1543B).

3.3.1.1 Toxic Products and Formulations

TRD3.3.1.1-1
The use of combustible materials or materials that can generate toxic outgassing or toxic products of combustion shall be compliant with applicable federal, state, and local laws and regulations.

3.3.1.2 Parts Selection

Care should be exercised in the selection of materials and processes for the space equipment to avoid stress corrosion cracking in highly stressed parts and to preclude failures induced by hydrogen embrittlement.

Parts, materials, and processes should be selected to ensure that any damage or deterioration from storage or the space environment or the outgassing effects in the space environment would not reduce the performance of the space equipment beyond the specified limits.

TRD3.3.1.2-1
Parts for space usage shall be chosen to meet the reliability and operational service life requirements (reference MIL-STD-1547B and also Preferred Parts List PPL-21, Goddard Space Flight Center).

TRD3.3.1.2-2
Parts shall be selected in accordance with the contractor's Parts Management Plan and the contractor shall be able to demonstrate via data or analysis that all parts meet the reliability and operational service life requirements.

TRD3.3.1.2-3
New items for the ground segments not supported by the logistics supply system shall be used only when existing items are incompatible with the NPOESS ground architecture, or they contain obsolete parts that are not available, or are no longer in production.

TRD3.3.1.2-4
New items shall be used only when the performance of existing items will not meet the requirements of this specification.

3.3.1.3 Material Selection

Materials for the space equipment will be selected for low outgassing in accordance with SP-R-0 022A (NASA JSC) and resistance to the effects of incident radiation. Materials selected for use in.

TRD3.3.1.3-1
Materials shall be selected that have demonstrated their suitability for the intended application.

TRD3.3.1.3-2
Materials shall be corrosion resistant or shall be suitably treated to resist corrosion when subjected to the specified environments.

TRD3.3.1.3-3
Where practicable, fungus inert materials shall be used.

TRD3.3.1.3-4
Class I Ozone Depleting Substances (ODS) shall not be used in the design, test, manufacture, integration and assembly, handling, transportation, operations, maintenance, or disposal of the NPOESS System.

TRD3.3.1.3-5
Use of Class II ODS and EPCRA Section 313 chemicals shall be identified and either eliminated or minimized, justified, and controlled.

TRD3.3.1.3-6
A Hazardous Materials Management Program shall be developed in accordance with NAS 411.

3.3.1.4 Finishes

TRD3.3.1.4-1
The finishes used shall ensure that the completed devices are resistant to corrosion.

TRD3.3.1.4-2
Neither cadmium nor zinc nor tin plating for space equipment shall be used.

3.3.2 Electromagnetic Radiation

TRD3.3.2-1
The satellite segment shall be electromagnetically compatible with itself.

TRD3.3.2-2
The ground segment shall be electromagnetically compatible with its known equipment and any existing equipment residing in the same facility.

TRD3.3.2-3
All support facilities, including test facilities and launch base facilities, shall comply with the ground EMC requirements.

TRD3.3.2-4
The EMC requirements shall be in accordance with MIL-STD-461D.and MIL-STD-1541A.

3.3.3 Nameplates and Product Marking

TRD3.3.3-1
Nameplates for hardware shall contain the item or configuration item number, serial number, lot number (or contract number), manufacturer, and nomenclature.

TRD3.3.3-2
Software media shall be marked to display software configuration item number, serial number, contract number, manufacturer, and nomenclature.

3.3.4 Workmanship

TRD3.3.4-1
Critical steps of fabrication which are item-peculiar shall be detailed in drawing notes which include appropriate workmanship criteria.

TRD3.3.4-2
Workmanship relating to all other aspects of fabrication shall be in accordance with the Quality Control Plan approved for each manufacturing facility.

3.3.5 Interchangeability

TRD3.3.5-1
All ground segments shall be configured for modular replacement of components to expedite maintenance and repair.

TRD3.3.5-2
All components, assemblies, subassemblies, and modules that are identical with respect to fit, form, and function shall be interchangeable.

TRD3.3.5-3
Parts not functionally, electrically and dimensionally interchangeable shall have different part numbers.

3.3.6 Safety Requirements

TRD3.3.6-1
System hazards to personnel, hardware, or the environment during design, test, manufacture, integration and assembly, handling, transportation, and operations of the NPOESS System shall be identified, controlled, or eliminated.

TRD3.3.6-2
Design and operational safety requirements shall be developed and implemented to eliminate or control personnel, hardware, or environmental hazards.

TRD3.3.6-3
Satellites developed for this program shall comply with EWR 127-1 in the areas of design safety, flight termination, launch integration, and ground operations.

TRD3.3.6-4
Software controlling hazardous systems or operations (e.g., propulsion systems, electro-explosive devices, electromechanical release devices, etc.) shall be assessed for hazard severity and probability (ref AFM 91-201and MIL-STD 882C).

TRD3.3.6-5
A system safety program shall be established (ref MIL-STD-882C).

3.3.7 Human Engineering

All new facilities and equipment designs, and the design of modifications to existing facilities and equipment should be in accordance with the provisions of MIL-STD-1472D.

TRD3.3.7-1
The operator-hardware and operator-software interfaces shall be designed to maximize safety, efficiency, and usability, and minimize number of personnel, resources, skills, and training.

TRD3.3.7-2
The operator-software interface shall be developed using open systems technology.

3.3.8 Nuclear Control

TRD3.3.8-1
Provisions shall be made for the control of all nuclear materials, such as radioactive sources, used in manufacturing, calibration, and checkout of certain mission sensors.

3.3.9 System Security

TRD3.3.9-1
System security procedures shall be consistent with the System Protection Guide.

3.3.9.1 COMSEC, TEMPEST, and COMPUSEC

3.3.9.1.1 Communications Security (COMSEC)

Communications security (COMSEC) measures provide protection for the transmission of sensitive information.

TRD3.3.9.1.1-1
All commands to the satellite shall be source authenticated.

TRD3.3.9.1.1-2
The satellite shall not accept invalid commands, noise, or spoofing as valid commands.

TRD3.3.9.1.1-3
Commands that fail authentication shall not be executed.

TRD3.3.9.1.1-4
Commands that fail authentication shall be reported in telemetry.

TRD3.3.9.1.1-5
A single failure shall not result in the disclosure of classified NPOESS information.

3.3.9.1.1.1 Data Deniability

Command and memory load data will always be encrypted. Telemetry and mission data (stored and real time) are denied only when the System is in autonomous mode, or when National Command Authority directs NPOESS to go into system encryption mode in times of national emergency. SDC and S&R data downlinked in real-time are always unencrypted (see 3.2.1.9 Data Access.)

TRD3.3.9.1.1.1-1
Satellite commands and memory loads shall be encrypted at the source (i.e. SOC) and decrypted at the final destination (i.e. NPOESS spacecraft) using modern, chip based National Security Agency (NSA) approved devices.

TRD3.3.9.1.1.1-2
During times of national emergency as determined by the National Command Authority, the System shall go into data encyption mode upon receipt of a ground command.

TRD3.3.9.1.1.1-3
When data denial is required, stored and real time telemetry and mission data downlinked by the satellite shall be encrypted at the source and decrypted at the final destination using commercially available DES or equivalent encryption systems. SDC data contained in the stored data downlink may be encrypted.

TRD3.3.9.1.1.1-4
The NPOESS user community receivers shall (as necessary) be equipped with commercially available encryption technology, such as Fortezza technology and recently declassified NSA encryption algorithms and associated key escrow account algorithms and procedures.

3.3.9.1.2 Compromising Emanations (TEMPEST)

NPOESS TEMPEST requirements should be based on site specific guidance while being consistent with the HIJACK and NONSTOP requirements of NACSEM 5112, and the requirements of NSTISSI 7000.

3.3.9.1.3 Computer Security (COMPUSEC)

Any NPOESS element that processes multiple security levels of data should comply with DOD 5200.28-STD, paragraph 3.1.1.3.

TRD3.3.9.1.3-1
NPOESS data shall reside in and operate under an environment that meets the class C2 criteria as defined by DOD 5200.28-STD paragraph 2.2.

TRD3.3.9.1.3-2
NPOESS shall provide the capability to verify the integrity and source of all information transferred between elements.

TRD3.3.9.1.3-3
NPOESS shall provide the capability to restrict subjects' (e.g., operators') privileges to access only those objects (e.g., data and programs) necessary to perform their tasks.

3.3.10 Government Furnished Property Usage

The NPOESS IPO will arrange for units of DoD Field Terminals to be made available for modification and test.

The SDC and S&R sensors for the NPOESS satellites will be provided to the NPOESS as GFE (with the exception of the antennas). Other sensors for the NPOESS satellites which will be GFE or directed subcontracts are *(TBS)*.

The government will furnish the appropriate encryption equipment.

Any military aircraft required to transport NPOESS satellites to the launch base will be provided as Government Furnished Services.

For each NPOESS satellite launch, the launch vehicle, its payload fairing, the use of the launch base facilities, and the support of the launch vehicle contractor may be provided by the US Government.

3.3.11 Computer Resources

Computer resources include all computer software and the associated computational equipment included within the System.

3.3.11.1 Operational Computer Resources

3.3.11.1.1 Operational Computational Equipment

The computational equipment includes processing units; special-purpose computational devices; main storage; peripheral data storage; input and output units such as printers, graphic displays, video display devices; and other associated devices.

3.3.11.1.2 Operating Systems Used in Operational Computers

TRD3.3.11.1.2-1
The operational computers shall be able to exchange information with their host facility systems.

TRD 3.3.11.1.2-2
The operating system shall be compliant IAW Joint Technical Architecture (JTA) compliance documents.

TRD 3.3.11.1.2-3
Software shall interface to the operating system IAW IEEE standards in JTA.

3.3.11.1.3 Operational Application Software

3.3.11.1.3.1 Programming Language

Where practicable, IDPS operational application computer software should be written in compliance with ANSI/ISO/TEC 8652:1955 Ada '95.

TRD3.3.11.1.3.1-1
System software shall be implemented using standard Ada (MIL-STD-1815A), C (ANSI STD X3/159-1989) or C++..

3.3.11.1.3.2 Message Generation

TRD3.3.11.1.3.2-1
The ground operational computer software shall generate error messages, diagnostic messages, and alarm messages on-line to facilitate real-time fault isolation required to maintain the System in operational status.

TRD3.3.11.1.3.2-2
In addition, these ground operational computer software shall generate off-line error and diagnostic messages for the logging of fault messages onto system files for those categories of faults which require isolation and correction but can be addressed off-line and do not degrade System performance.

3.3.11.1.3.3 Computer Resource Utilization Monitoring

TRD3.3.11.1.3.3-1
All ground operational computer resources shall provide a capability which can be exercised under operator control to monitor, record, display, and print the utilization of the various computer resources.

TRD3.3.11.1.3.3-2
All space operational computer resources shall provide a capability which can be exercised under operator control to monitor and record the utilization of the various computer resources.

3.3.11.1.4 Reuse of Legacy Code

TRD3.3.11.1.4-1
Code from legacy systems shall be reused for NPOESS to the maximum extent possible and where appropriate. Further guidance can be found in *Guidance for Software Reuse for the NPOESS Program, (TBS).*

3.3.11.1.5 Software Coding Conventions

TRD3.3.11.1.5-1
All software code shall be designed and written for future reuse according to modern industry and DoD practices as referenced in Guidance for Software Reuse for the NPOESS Program *(TBS).*

TRD3.3.11.1.5-2
Code shall be written such that no code is modified during execution.

3.3.11.1.6 Year 2000 Software Requirements

TRD3.3.11.1.6-1
All information technology items shall be Year 2000 compliant, or non-compliant items shall be upgraded at no additional cost to be Year 2000 compliant by *(TBS)*, but NLT December 31, 1999. Year 2000 compliant means information technology that accurately processes date/time data (including but not limited to, calculating, comparing and sequencing) from, into, and between the twentieth and twenty-first centuries, and the years 1999 and 2000 and leap year calculations.

TRD3.3.11.16-2
Year 2000 compliant information technology, when used in combination with other information technology, shall accurately process date/time data if the other information technology properly exchanges date/time data with it.

3.3.11.2 Computer Resources in Test Equipment

Test equipment is that equipment required to support the maintenance, repair, and checkout of the System hardware following System deployment.

3.3.11.3 Computer Resources in Training Equipment

TRD3.3.11.3-1
To the extent practicable, the computational training equipment that provides operator displays and controls shall be identical to the corresponding operational computational equipment.

3.3.12 Satellite Design Requirements

3.3.12.1 General Structural Design

The primary support structure for the space equipment should possess sufficient strength, rigidity, and other characteristics required to survive the critical loading conditions that exist within the envelope of handling and mission requirements.

3.3.12.2 Strength Requirements

3.3.12.2.1 Yield Load

TRD3.3.12.2.1-1
The structure shall be designed to have sufficient strength to withstand simultaneously the yield loads, applied temperature, and other accompanying environmental phenomena for each design condition without experiencing yielding or detrimental deformation.

3.3.12.2.2 Ultimate Load

TRD3.3.12.2.2-1
The structure shall be designed to withstand simultaneously the ultimate loads, applied temperature, and other accompanying environmental phenomena without failure.

3.3.12.3 Stiffness Requirements

3.3.12.3.1 Dynamic Properties

TRD3.3.12.3.1-1
The structural dynamic properties of the equipment shall be such that its interaction with the satellite control subsystem does not result in unacceptable degradation of performance.

3.3.12.3.2 Structural Stiffness

TRD3.3.12.3.2-1
Stiffness of the structure and its attachments shall be controlled by the equipment performance requirements and by consideration of the handling and launch environments.

TRD3.3.12.3.2-2
Special stowage provisions shall be used, if required, to prevent excessive dynamic amplification during transient flight events.

3.3.12.3.3 Component Stiffness

TRD3.3.12.3.3-1
The fundamental resonant frequency of a component weighing 23 kilograms or less shall normally be 50 Hertz or greater when mounted on its immediate support structure.

TRD3.3.12.3.3-2
Detailed analyses of the potential responses of the component to inputs from the adjoining structure(s) shall be required for components weighing 23 kilograms or less and having fundamental resonant frequencies of less than 50 Hertz.

3.3.12.4 Structural Factors of Safety

The factor of safety of the structure is the ratio of the limit load to the allowable load.

3.3.12.4.1 Flight Limit Loads

TRD3.3.12.4.1-1
The structure shall comply with the required structural design factors of safety listed in Table I.

TABLE I. STRUCTURAL DESIGN FACTORS OF SAFETY

Design/Test Options	Factors of Safety (Yield)	Factors of Safety (Ultimate)	Test Level Factors
1. Dedicated Test Article	1.100	1.25	1.25
2. Test on Flight Article	1.25	1.40	1.25
3. Proof Test Each Flight Article	1.10	1.25	1.1
4. No Static Test	1.60	2.00	N/A

The dedicated test article option is a qualification test article that will be subjected to the maximum expected loads times a test level factor of 1.25. The test on flight article option refers to a protoqualification on the structure at the same test level factor.

3.3.12.4.2 Pressure Loads

TRD3.3.12.4.2-1
Factors of safety for pressure loads shall be determined individually for each pressure vessel, based on tests to establish material characteristics and an analysis of life requirements and other environmental exposure.

TRD3.3.12.4.2-2
Proof and burst pressure factors shall be established at levels that ensure structural integrity, structural life, and safety throughout all phases. The values listed in Table II are to be considered as limiting lower bounds.

TABLE II. FACTORS OF SAFETY FOR PRESSURIZED COMPONENTS

	Design	Acceptance	Qualification
Component	Ultimate	Proof	Burst
Solid Rocket Motor Cases[a]	1.25	1.10[b]	1.25[b]
Pneumatic Vessels (SVE)[a]	2.00	1.50[b]	2.00[b]
Pneumatic Vessels (GSE)[a]	4.00	2.00[b]	4.00[b]
Lines, Fittings, and Hoses			
Less than 3.81 cm diameter	4.00	2.00[b]	4.00[b]
3.81 cm diameter and larger	1.50	1.10[b]	1.50[b]
Other Pressurized Components	2.50	2.00[b]	2.50[b]

Notes:
a. Factors of safety shown are minimum values applicable to metallic pressure vessels for which ductile fracture mode is predicted via a combination of stress and fracture mechanics analyses. Design of metallic pressure vessels for which brittle fracture mode is predicted by these analyses should be in accordance with fracture mechanics methodology wherein the proof factor as well as the design ultimate factor of safety should be established to provide a minimum of four times the specified service life against mission requirements. In addition, a fracture control program should be established to prevent structural failure due to the initiation or propagation of flaws or crack-like defects during fabrication, testing, and service life. SVE = Space Vehicle Equipment; GSE = Ground Support Equipment.

b. No measurable *(TBR)* yielding is permitted at acceptance (proof) test pressure and no rupture at qualification pressure.

3.3.12.5 Design Load Conditions

TRD3.3.12.5-1
The satellite equipment shall be capable of withstanding all design load conditions to which it is exposed in all mission phases, as applicable: ground, prelaunch, erection, post-launch, boost and orbit.

TRD3.3.12.5-2
During the orbit phase, all of the following shall be considered: maneuvering loads, vehicle spin, meteoroid environment, radiation environment, and other environmental factors, such as thermal effects due to internal heating, solar heating, eclipses, and extreme cold due to ambient space environment.

3.3.12.6 Satellite Fluid Subsystems

3.3.12.6.1 Pressurized Components

Fluid subsystem and pressurized components should be in accordance with MIL-STD-1522A.

TRD3.3.12.6.1-1
EWR127-1 shall be used for design and test of all pressurized systems.

3.3.12.6.2 Tubing

TRD3.3.12.6.2-1
Tubing design shall incorporate provisions for cleaning and to allow proof testing.

3.3.12.6.3 Separable Fittings

TRD3.3.12.6.3-1
Separable fittings shall have redundant sealing surfaces, such as double *"O"* rings, and be of the *"parallel loaded"* type. *"Parallel loaded"* means that the fitting contains a compressed element which exerts outward pressure on the other elements of the fitting such that both seals are maintained even if relaxation occurs.

TRD3.3.12.6.3-2
Separable fittings shall have provisions for locking.

TRD3.3.12.6.3-3
Separable fittings shall be accessible for leak tests and for torque checks.

TRD3.3.12.6.3-4
Separable fittings shall not be designed or assembled with lubricants or fluids that could cause contamination or could mask leakage of a poor assembly.

TRD3.3.12.6.3-5
Separable fluid fittings shall not use "B" nuts unless all of the following constraints are met:
(1) The fittings are comprised of one or more compressed or internally pressure-energized members which maintain a seal even if stress relaxation occurs in any of the other components.
(2) The fittings have redundant seals in series.
(3) The fittings are lockwired to prevent any rotation between the fitting and the nut.

3.3.12.7 Moving Mechanical Assemblies

TRD3.3.12.7-1
Deployment mechanisms, sensor mechanisms, pointing mechanisms, drive mechanisms, de-spin mechanisms, separation mechanisms, and other moving mechanical assemblies on satellites shall be in accordance with MIL-A-83577B.

3.3.12.8 Explosive Ordnance

TRD3.3.12.8-1
All safety-related explosive ordnance design requirements shall be met.

TRD3.3.12.8-2
Explosive ordnance to be installed on a satellite shall be in accordance with DOD-E-83578A.

3.3.12.9 Wiring

See 3.2.4.3.3.

3.3.12.10 Electronic Components

See paragraph 3.3.1.2 Parts Selection.

3.3.12.11 Solar Arrays

(TBD)

3.3.13 Operational Ground Equipment: General Design Requirements

3.3.13.1 General Structural Design

TRD3.3.13.1-1
The primary support structure for the ground equipment shall possess sufficient strength, rigidity, and other characteristics required to survive the critical loading conditions that exist within the envelope of handling and mission requirements.

TRD3.3.13.1-2
The primary support structure of the equipment shall be electrically conductive.

TRD3.3.13.1-3
The primary support structure of the equipment shall permit the implementation of a single-point electrical ground.

3.3.13.2 Strength Requirements

3.3.13.2.1 Yield Load

TRD3.3.13.2.1-1
The structure shall be designed to have sufficient strength to withstand simultaneously the yield loads, applied temperature, and other accompanying environmental phenomena for each design condition without experiencing yielding or detrimental deformation.

3.3.13.2.2 Ultimate Load

TRD3.3.13.2.2-1
The structure shall be designed to withstand simultaneously the ultimate loads, applied temperature, and other accompanying environmental phenomena without failure.

3.3.13.3 Stiffness Requirements

3.3.13.3.1 Dynamic Properties

TRD3.3.13.3.1-1
The structural dynamic properties of the equipment shall be such that its interaction with the environment does not result in unacceptable degradation of performance.

3.3.13.3.2 Structural Stiffness

TRD3.3.13.3.2-1
Stiffness of the structure and its attachments shall be controlled by the equipment performance requirements and by consideration of the handling, transport, and operational environments.

TRD3.3.13.3.2-2
Special stowage and tie-down provisions shall be used, if required, to prevent excessive dynamic amplification during transient events such as installation and transport.

3.3.13.4 Structural Factors of Safety

The factor of safety of the structure is the ratio of the limit load to the allowable load.

3.3.13.4.1 Transport Limit Loads

TRD3.3.13.4.1-1
Available options for structural design are listed in Table III. All safety-related structural design requirements shall be met.

TABLE III. GROUND EQUIPMENT STRUCTURAL DESIGN FACTORS OF SAFETY

	Design Factor of Safety on Limit Loads	
Design and Test Options	Yield	Ultimate
1. Static Proof Test Each Air Transportable Article	1.10	1.40
2. No Static Test (analysis only)	1.60	2.25

3.3.13.4.2 Pressure Loads

TRD3.3.13.4.2-1
Factors of safety for pressure loads shall be determined individually for each pressure vessel, based on tests to establish material characteristics and an analysis of life requirements and other environmental exposure.

TRD3.3.13.4.2-2
Proof and burst pressure factors shall be established at levels that ensure structural integrity, structural life, and safety throughout all phases.

TRD3.3.13.4.2-3
The limiting lower bounds for all safety-related pressurized component design requirements listed in Table IV shall be met for all equipment.

TABLE IV. FACTORS OF SAFETY FOR GROUND EQUIPMENT PRESSURIZED COMPONENTS

	Design	Acceptance	Qualification
Component	Ultimate	(Proof)	
Pneumatic Vessels[a]	4.00	2.00[b]	4.00[b]
Lines, Fittings, and Hoses			
Less than 3.81 cm diameter	4.00	2.00[b]	4.00[b]
3.81 cm diameter and larger	1.50	1.10[b]	1.50[b]
Other Pressurized Components	2.50	2.00[b]	2.50[b]

Notes:

a. Factors of safety shown are minimum values applicable to metallic pressure vessels for which ductile fracture mode is predicted via a combination of stress and fracture mechanics analyses. Design of metallic pressure vessels for which brittle fracture mode is predicted by these analyses should be in accordance with fracture mechanics methodology wherein the proof factor as well as the design ultimate factor of safety should be established to provide a minimum of four times the specified service life against mission requirements. In addition, a fracture control program should be established to prevent structural failure due to the initiation or propagation of flaws or crack-like defects during fabrication, testing, and service life.

b. No yielding is permitted at acceptance (proof) test pressure and no rupture at qualification pressure.

TRD3.3.13.4.2-4
Federal, State, and local safety regulations shall be met.

3.3.13.5 Design Load Conditions

TRD3.3.13.5-1
The equipment shall be capable of withstanding all design load conditions to which it is exposed.

3.3.13.5.1 Air Transportation Load Factors

TRD3.3.13.5.1-1
The load factors applied to the C-130, C-141, C-5 and C-17 air transport environments shall be 1.5.

3.3.13.5.2 Ground Transportation Load Factors

TRD3.3.13.5.2-1
The ground transportation load factors shall be 1.5.

3.3.13.6 Fluid Subsystems

3.3.13.6.1 Pressurized Components

Fluid subsystems and pressurized components should be in accordance with MIL-STD-1522A.

3.3.13.6.2 Tubing

TRD3.3.13.6.2-1
Tubing shall be stainless steel, where practicable.

TRD3.3.13.6.2-2
Tubing joints shall be thermal welded butt joints, where practicable.

TRD3.3.13.6.2-3
Tubing design shall incorporate provisions for cleaning and to allow proof testing.

3.3.13.6.3 Separable Fittings

TRD3.3.13.6.3-1
Separable fittings shall have provisions for locking. Separable fittings should be accessible for leak tests and for torque checks. Separable fittings should not be designed or assembled with lubricants or fluids that could cause contamination or could mask leakage of a poor assembly.

3.3.14. Test Equipment

Test equipment is that equipment required to support the maintenance, repair, and checkout of the System following System deployment.

TRD3.3.14-1
To the extent practicable, test equipment shall be designed using applicable commercial practices.

TRD3.3.14. -2
Commercially available modules shall be used to the extent practicable.

3.3.15 General Construction Requirements

3.3.15.1 Processes and Controls for Space Equipment

Acceptance and flight certification of space equipment is based primarily on an evaluation of data from the manufacturing process.

TRD3.3.15.1-1
The manufacturing process for space equipment shall be accomplished in accordance with documented procedures and process controls which assure the reliability and quality required for the mission.

TRD3.3.15.1-2
These manufacturing procedures and process controls shall be documented to give visibility to the procedures and specifications by which all processes, operations, inspections, and tests are to be accomplished by the supplier.

TRD3.3.15.1-3
This internal contractor documentation shall include the name of each part or component, each material required, the point it enters the manufacturing flow, and the controlling specification or drawing.

TRD 3.3.15.1-4
The documentation shall indicate required tooling, facilities, and test equipment; the manufacturing check points; the quality assurance verification points; and the verification procedures corresponding to each applicable process or material listed.

TRD3.3.15.1-5
The specifications, procedures, drawings, and supporting documentation shall reflect the specific revisions in effect at the time the items were produced.

TRD3.3.15.1-6
These flow charts and the referenced specifications, procedures, drawings, and supporting documentation become the manufacturing process control baseline and shall be retained by the supplier for reference.

TRD3.3.15.1-7
It is recognized that many factors may warrant making changes to this documented baseline; however, all changes to the baseline processes used, or the baseline documents used, shall be recorded by the supplier following establishment of the manufacturing baseline. These changes provide the basis for flight accreditation of the items manufactured or of subsequent flight items.

TRD3.3.15.1-8
The manufacturing process and control documents for space equipment shall provide a supplier-controlled baseline that assures that any subsequent failure or discrepancy analysis that may be required can identify the specific manufacturing materials and processes that were used for each item. In that way, changes can be incorporated to a known baseline to correct the problems.

3.3.15.1.1 Assembly Lots

TRD3.3.15.1.1-1
To the extent practicable, parts for use in space equipment shall be grouped together in individual assembly lots during the various stages of their manufacture to assure that all devices assembled during the same time period use the same materials, tools, methods, and controls.

TRD3.3.15.1.1-2
Parts and devices for space equipment that cannot be tested adequately after assembly without destruction of the item, such as explosive ordnance devices, some propulsion components, and complex electronics, shall have lot controls implemented during their manufacture to assure a uniform quality and reliability level of the entire lot.

TRD3.3.15.1.1-3
Each lot shall be manufactured, tested, and stored with sequential lot numbers that indicate the date of manufacture assigned to each lot. (Typically, use three digits for the day of the year and four digits for the year.)

3.3.15.1.2 Contamination

As part of the contamination control analysis and ICD development, the integrating contractor is to perform a particulate and molecular plume flowfield analysis for all spacecraft thrusters...

3.3.15.1.2.1 Fabrication and Handling

TRD3.3.15.1.2.1-1
Fabrication and handling of space equipment shall be accomplished in a clean environment.

TRD3.3.15.1.2.1-2
Attention shall be given to avoiding non-particulate (chemical) as well as particulate air contamination.

TRD3.3.15.1.2.1-3
To avoid safety and contamination problems, the use of liquids shall be minimized in areas where initiators, explosive bolts, or any loaded explosive devices are exposed.

3.3.15.1.2.2 Device Cleanliness

The particulate cleanliness of internal moving subassemblies should be maintained to at least level 500 as defined in MIL-STD-1246C.

TRD3.3.15.1.2.2-1
External surfaces shall be visibly clean.

3.3.15.1.2.3 Outgassing

TRD3.3.15.1.2.3-1
Items that might otherwise produce deleterious outgassing while on orbit shall be baked for a sufficient time to drive out all but an acceptable level of outgassing products prior to installation in the experiment or satellite.

TRD3.3.15.1.2.3-2
Analytical contamination models shall be used to evaluate performance impacts of outgassing on adjacent critical equipment.

3.3.15.1.3 Electrostatic Discharge

TRD3.3.15.1.3-1
Appropriate provisions shall be used to avoid and to protect against the effects of static electricity generation and discharge in areas containing electrostatic sensitive devices such as microcircuits, initiators, explosive bolts, or any loaded explosive device. MIL-HDBK-263B provides examples of appropriate provisions.

TRD3.3.15.1.3-2
There shall be a capability to ground both equipment and personnel working on and around the satellite, subsystems, and components. All support facilities, including test facilities and launch base facilities, should comply with the grounding requirements of MIL-STD-1542B and NOAA S24.809.

3.3.15.1.4 Mechanical Interfaces

TRD3.3.15.1.4-1
Where practicable, a common interface drill template shall be used to assure correct mechanical mating, particularly for interfaces external to the equipment.

3.3.15.2 Processes and Controls for Ground Equipment

TRD3.3.15.2-1
The manufacturing processes and controls for ground equipment shall be selected and documented using the same criteria as used in the manufacture of similar commercial equipment.

3.4 DOCUMENTATION

3.4.1 Specifications

TRD3.4.1-1
Functional and physical requirements for the NPOESS System shall be documented in a hierarchical set of specifications, comprising system, segment, and element levels. MIL-STD-961D, Notice 1 provides guidance on hierarchical specifications. Lower level specifications are able to be used to define requirements for software or individual units.

3.4.1.1 Facility Drawings

TRD3.4.1.1-1
Installation drawings shall be prepared for each facility, showing the locations of fixed equipment and the utilities required to serve it. For easily relocateable equipment such as computer workstations or desktop printers, locations are shown for their network connections.

3.4.2 Interface Control Documents

TRD3.4.2-1
Interface Control Documents (ICDs) shall be used to define and control the interfaces within the NPOESS System and between the NPOESS System and external users.

TRD3.4.2-2
ICDs shall be provided for spacecraft bus to all mission sensors.

TRD3.4.2-3
An ICD shall be provided for METOP bus to mission sensors (*TBS).*

TRD3.4.2-4
An ICD shall be provided for Space Segment to C3 Segment.

TRD3.4.2-5
An ICD shall be provided for Space Segment to non-NPOESS mission sensors (such as S&R sensor).

TRD3.4.2-6
An ICD shall be provided for C3 Segment to IDP Segment.

TRD3.4.2-7
An ICD shall be provided for Launch Support Segment to Spacecraft.

TRD3.4.2-8
An ICD shall be provided for Launch Support Segment to C3 Segment.

TRD3.4.2-9
An ICD shall be provided for Intra-Segment Element to Element.

TRD3.4.2-10
An ICD shall be provided for IDP Segment to Centrals.

TRD3.4.2-11
An ICD shall be provided for NPOESS SOCs to METOP SOC.

TRD3.4.2-11
An ICD shall be provided for NPOESS Space Segment and/or C3 to each non-NPOESS unique C3 equipment at AFSCN, NOAA, commercial, and/or and METOP command data acquisition sites as applicable.

3.4.3 Drawings and Associated List

TRD3.4.3-1
Equipment designed for NPOESS shall be documented in drawings and associated lists.

3.4.4 Software (Including Databases).

NPOESS software and databases should be developed and managed in accordance with EIA/IEEE J-STD-016.

TRD3.4.4-1
All software and databases shall be developed for future reuse as defined in Guidance for Software Reuse for the NPOESS Program *(TBS)*.

3.4.5 Technical Manuals

All technical manuals will be commercial off-the-shelf, if adequate descriptive documentation is contained within the manuals to perform the tasks intended. If this is not the case, then all technical manuals should meet the requirements of NOAA Standards S24.801 and S24.806, TM 86-01, and other applicable specifications.

TRD3.4.5-1
The Technical Manuals Plan shall govern the development and/or delivery of all required hardware and software maintenance and operations manuals.

3.5 LOGISTICS

Integrated Logistics Support (ILS) should minimize the impact of NPOESS on the existing support infrastructure while ensuring the lowest NPOESS life cycle cost and while providing full and timely logistics response. This goal should be accomplished by the application of sound supportability decisions regarding mission equipment design, support systems development, and support products acquisition.

TRD3.5-1
Supportability criteria shall be imposed on equipment selection and System designs to minimize the System life cycle costs.

3.5.1 Maintenance Planning

All maintenance procedures will be approved by the USG.

3.5.1.1 Space Segment Maintenance Concepts

The space ground support equipment should be addressed in the space segment.

3.5.1.2 C3 Segment Maintenance Concepts

The NPOESS-provided C3 Ground Equipment will be operated by a mix of USG civilian and military personnel and contractors. The USG requires maintenance of the NPOESS C3 Ground Equipment including equipment installed at the SOCs and any NPOESS unique equipment installed at the command data acquisition stations. This maintenance is required during development, installation, Initial Operational Test and Evaluation (IOT&E), Initial Operations, and for 12 months after full operational capability (FOC) is certified..

TRD3.5.1.2-1
Remedial and preventive maintenance of the C3 Ground Equipment (including COTS) is an NPOESS contractor function and shall be consistent with requirements for overall NPOESS System availability and reliability.

TRD3.5.1.2-2
The NPOESS System delivered shall include options for additional one year periods of C3 Ground Equipment hardware and software maintenance upgrades throughout the program life cycle.

TRD3.5.1.2-3
The C3 Ground Equipment shall have sufficient diagnostic and failure detection capabilities (hardware and software) to allow USG operations staff to be alerted immediately to system failures and complete fault isolation within 30 minutes.

TRD3.5.1.2-4
The C3 Ground Equipment which experiences a failure shall be returned to operations within 4 hours.

TRD3.5.1.2-5
The C3 Ground Equipment shall be configured to allow hardware and software components to be repaired or replaced without the loss of data or spacecraft mission to a level meeting specified NPOESS data availability requirements. Approved procedures will predetermine repair or replacement of hardware.

TRD3.5.1.2-6
A maintenance capability shall be provided for the NPOESS unique equipment at the SOCs and at the command data acquisition stations on 24 hours per day, 7 days per week basis.

TRD3.5.1.2-7
A response time of 30 minutes or less shall be provided for this support.

3.5.1.3 IDP Segment Maintenance Concept

TRD3.5.1.3-1
The maintenance concept for the IPD segment shall cover all non-GFE equipment, parts, labor, and software (including COTS).

TRD3.5.1.3-2
The IDPS equipment with the failed components shall be returned to operations within 4 hours.

TRD3.5.1.3-3
Fault isolation shall be completed within 30 minutes after failure occurrence.

3.5.1.3.1 Centrals

IDPS hardware and software require operational maintenance at all central sites. The maintenance tasks associated with the IDPS at DoD and NOAA will be different. Maintenance requirements defined in this section relating only to the production and delivery of EDRs refer exclusively to the DoD IDPS locations.

TRD3.5.1.3.1-1
For both NOAA and DoD, remedial and preventive maintenance of interface hardware delivered to acquire NPOESS data streams at Centrals is expected to be an NPOESS contractor function and shall be consistent with stated requirements for NPOESS data availability and product delivery timeliness.

TRD3.5.1.3.1-2
Maintenance of the entire IDPS, including processing equipment and software needed to generate EDRs at DoD Centrals, shall be provided during development, installation, Initial Operational Test and Evaluation (IOT&E), Initial Operations, and for 12 months after full operational capability (FOC) is certified.

TRD3.5.1.3.1-3
The IDPS at Centrals shall have sufficient diagnostic and failure detection capabilities (hardware and software) to allow USG operations staff to be alerted immediately to system failures.

TRD3.5.1.3.1-4
The IDPS at Centrals shall be configured to allow hardware and software components to be repaired or replaced without the loss of data to a level meeting specified NPOESS data availability requirements. Approved procedures will predetermine hardware repairs or replacements.

TRD3.5.1.3.1-5
Sufficient redundancy shall exist that hardware and software upgrades can be installed and tested on non-critical portions of the system without affecting the ongoing operations.

3.5.1.3.2 DoD Field Terminals.

Field level maintenance of the hardware and software at the DoD field terminals is required and will be performed by DoD following appropriate IDPS hardware and software maintenance training, and consistent with the field terminal operations and maintenance concepts.

TRD3.5.1.3.2-1
Non-field hardware and software maintenance of the IDPS elements of the DoD field terminals (formerly referred to a “depot level maintenance”) shall be provided for 12 months after full operational capability (FOC) is certified.

3.5.2 Provisioning Strategy/Spares Concept

Spare parts should be provided for the NPOESS C3 Ground Equipment and IDP segment subsystems to ensure NPOESS data availability requirements.

TRD3.5.2-1
In time of international crisis or heightened tensions, the number of parts advance-stocked for the NPOESS C3 and IDPS shall be increased to the number expected to be required during a one year period.

3.5.3 Support Equipment

The need for unique support equipment should be minimized by the careful selection of COTS hardware and software.

3.5.4 Packaging, Handling, Storage, and Transportation (PHS&T).

TRD3.5.4-1
The contractor shall provide a PHS&T plan which will cover all PHS&T issues for the NPOESS program.

3.5.5 Facilities.

Existing government facilities may be available for operations, maintenance, or storage of NPOESS system components.

3.6 PERSONNEL AND TRAINING

TRD3.6-1
A Training System Requirement Analysis and Training Plan shall be developed outlining training requirements to prepare personnel for NPOESS operations and software/hardware maintenance. These should be developed using the Training System Requirements Analysis Book as a guide.

3.6.1 C3 Segment.

The goal for NPOESS C3 Segment training is for USG operations and maintenance personnel to be certified as qualified to operate the hardware and software of the NPOESS C3 Ground Equipment. Qualification will be certified by the contractor training instructors following execution of a training plan subject to USG approval.

TRD3.6.1-1
The training plan to meet this goal shall cover all aspects of hardware and software needed to insure operational continuity of the NPOESS C3 Segment. The plan should be developed using NOAA Standards S24.804 and S24.806 as guides.

3.6.2 IDP Segment.

The goal of IDPS training is for USG operations and maintenance personnel to be certified as qualified to operate and maintain the hardware and software of the IDPS. Qualification will be certified by the contractor training instructors following execution of a training plan subject to USG approval.

TRD3.6.2.-1
A training plan to meet this goal covering all aspects of hardware and software needed to insure operational continuity of the NPOESS data acquisition, data quality control, and EDR processing and distribution shall be provided. The plan should be developed using NOAA Standards S24.804 and S24.806 as guides.

TRD3.6.2.-2
All USG operations staff shall be fully trained before IOC.

3.7 SEGMENT CHARACTERISTICS

This section states the requirements that have been allocated to the segments. However, to avoid duplication requirements that normally would appear in both 3.2 and 3.7 are only stated in this section.

3.7.1 Space Segment (SS)

The space segment consists of a constellation of satellites and ground support equipment.

TRD3.7.1-1
The space segment shall be capable of supporting an individual satellite in each of the satellite modes (defined in 3.7.1.2.1 Satellite Modes) simultaneously.

3.7.1.1 Constellation Requirements

NPOESS satellites should be equally spaced to the maximum extent possible and should provide adequate coverage of the dawn/dusk transitions and the approximate noon/midnight fluctuations of the ionosphere and magnetosphere.

TRD3.7.1.1-1
NPOESS satellites shall be flown at a nodal crossing time of approximately 0530 LST (decending), approximately 1330 LST (ascending), and 2130 (ascending) to optimize satisfaction of DoD and DOC requirements. The 2130 orbit may be satisfied by METOP flying NPOESS furnished sensors. If the 2130 orbit is satisfied by the METOP satellite, then only two US NPOESS satellites will be needed; they will be flown in the 0530 and 1330 orbits.

TRD3.7.1.1-2
All satellites in the NPOESS constellation shall be sun-synchronous such that each satellite images/measures the same latitude at approximately the same local solar time (LST) each day.

TRD3.7.1.1-3
The NPOESS satellites shall be capable of flying at any equatorial nodal crossing time. As a goal, the equatorial node crossing times should be selectable by the users and the constellation should still achieve mission requirements.

TRD3.7.1.1-4

The orbit altitude for all satellites in the NPOESS constellation shall be 833km.

TRD3.7.1.1-5
The orbit inclination for all satellites in the NPOESS constellation shall be 98.7 degrees.

3.7.1.2 Satellite Requirements

TRD3.7.1.2-1
The satellite shall be capable of being launched into the specified orbit from VAFB on a LV.

TRD3.7.1.2-2
A NPOESS satellite shall commence safe operations when an anomalous condition occurs from which the satellite is not able to automatically recover and which threatens the health and status of the satellite in a time frame that is not sufficient for the anomaly to be resolved.

TRD3.7.1.2-3
During safe operations, the satellite shall sustain the capability to receive a command uplink from the C3 Segment and to transmit a real-time health and status telemetry downlink to the C3 Segment.

TRD3.7.1.2-4
Once safe operations are no longer required, the satellite shall cease safe operations and commence normal operational mode upon ground command from the C3 Segment.

TRD3.7.1.2-5
The NPOESS satellites shall be configured to reduce the generation of space debris to the maximum extent possible in accordance with National Space Policy Directive 1 and USSPACECOM Reg 57-2. As a goal, NPOESS satellites should be configured so when they are either non-mission capable or nearing their end of life, they can be removed from operational orbits.

TRD3.7.1.2-6
The NPOESS satellites shall operate in the natural environments of their operational orbits. The following references contain specifications of the natural environment:. MIL-STD-1809 (USAF) Space Environments for USAF Space Vehicles; NASA SP-8031: NASA Space Vehicle Design Criteria / Structures; NASA Tech Memorandum 100471: Orbital Debris Environments for Spacecraft Designed to Operate in Low Earth Orbit; and the Handbook of Geophysics and Space Environments.

TRD3.7.1.2-7
The satellite shall be able to separately command any sensor suite into any sensor mode.

TRD3.7.1.2-8
GPS or equivalent shall be used to meet positioning requirements derived from Appendix D EDR requirements. (ICD-200)

3.7.1.2.1 Satellite Modes

3.7.1.2.1.1 Off Mode

TRD3.7.1.2.1.1-1
In the Off Mode, no power shall be supplied to the satellite.

3.7.1.2.1.2 Operational Mode

TRD3.7.1.2.1.2-1
The sensors shall have one or more Operational Modes for collecting data as defined in the applicable sensor-spacecraft ICDs.

TRD3.7.1.2.1.2-2
The sensor shall be fully operational in at least one of the operational modes.

3.7.1.2.1.3 Safe Hold Mode

In the case of an anomalous satellite event, it may be necessary to enter the Safe Hold Mode to protect the satellite.

TRD3.7.1.2.1.3 -1
The C&DH shall be capable of re-configuring the satellite to a safe condition.

TRD3.7.1.2.1.3 -2
Ground intervention shall be required to return to the Operational Mode.

3.7.1.2.1.4 Autonomous Mode

TRD3.7.1.2.1.4-1
In the Autonomous Mode, the satellite shall be capable of operating for up to a minimum of 21 days, with an objective of 60 days without additional commands from the ground. (See 3.2.1.3 Autonomous Mode Capability.)

3.7.1.2.1.5 Diagnostic Mode

TRD3.7.1.2.1.5-1
Diagnostic Mode shall include housekeeping, troubleshooting, testing, and software updates.

3.7.1.3 Ground Support Equipment

TRD3.7.1.3.1-1
Ground Support Equipment shall be provided by the contractor to satisfactorily perform tests that will demonstrate that the satellite meets all of the requirements. This includes subsystem testing, systems test, and unique equipment for launch support.

3.7.1.4 Sensor Suites

All passive microwave sensor sounding bands should be in either the dedicated, or the shared, ITU tables for passive sensor use IAW the "Manual of Regulations and Procedures for Federal Radio Frequency Management" September 1995 Edition.

TRD3.7.1.4-1
Where applicable, each sensor channel shall be commandable .

3.7.1.4.1 Visible/Infrared Imager Radiometer Suite (VIIRS)

TRD3.7.1.4.1-1
The Visible/Infrared Imager Radiometer Suite (VIIRS) shall meet the requirements as specified in the NPOESS VIIRS SRD.

3.7.1.4.2 Cross-Track Infrared Microwave Sounding Suite (CrIMSS)

3.7.1.4.2.1 Cross-Track Infrared Spectrometer (CrIS)

TRD3.7.1.4.2.1-1
The Cross-Track Infrared Spectrometer (CrIS) shall meet the requirements as specified in the NPOESS CrIS SRD.

3.7.1.4.2.2 Cross-Track Microwave Sensor Sounding Suite

TRD3.7.1.4.2-2
The Cross-Track Microwave Sensor Sounding Suite shall augment the other sensors’ capabilities as necessary to meet the EDR requirements in Appendix D.

3.7.1.4.3 Conical Microwave Imager Suite (CMIS)

TRD3.7.1.4.3-1
The Conical Microwave Imager Suite (CMIS) shall meet the requirements as specified in the NPOESS CMIS SRD.

3.7.1.4.4 Space Environmental Suite (SES)

The Space Environmental Suite consists of sets of sensors that provide data on electron density profiles, neutral density, solar extreme ultraviolet radiation, geomagnetic field, precipitating electrons and ions, electric field/ion drift velocity, radiation dose, neutral atmosphere, galactic cosmic rays, trapped particles, ionospheric scintillation, auroral emissions and airglow image, in-situ plasma measurements and other selected space environmental parameters.

TRD3.7.1.4.4-1
The Space Envrionmental Sensor Suite (SES) shall meet the requirements as specified in the NPOESS SES SRD *(TBS)*.

3.7.1.4.5 GPS Occultation Suite (GPSOS)

TRD3.7.1.4.5-1
The GPS Occultation Suite (GPSOS) shall meet the requirements as specified in the NPOESS GPSOS SRD.

3.7.1.4.6 Ozone Mapping Profiling Suite (OMPS)

TRD3.7.1.4.6-1
The Ozone Mapping Profiling Suite (OMPS) shall meet the requirements as specified in the OMPS SRD.

3.7.1.4.7 Surface Data Collection (SDC)

TRD3.7.1.4.7-1
The NPOESS Space Segment shall have the capability to provide SDC on at least 2 (*TBR*) satellites.

3.7.1.4.8 Search and Rescue (S&R)

TRD3.7.1.4.8-1
The NPOESS Space Segment shall have the capability to provide S&R functions on at least 2 (*TBR*) satellites.

3.7.1.4.9 Cloud and Earth Radiant Energy System (CERES)

TRD3.7.1.4.9-1
The Cloud and Earth Radiant Energy System (CERES) shall augment the other sensors' capabilities as necessary to meet the EDR requirements in Appendix D.

3.7.1.4.10 Altimeter

TRD3.7.1.4.10-1
The Altimeter shall augment the other sensors' capabilities as necessary to meet the EDR requirements in Appendix D.

3.7.1.4.11 Total Solar Irradiance Sensor (TSIS)

TRD3.7.1.4.10-1
The Altimeter shall augment the other sensors' capabilities as necessary to meet the EDR requirements in Appendix D.

3.7.2 Command, Control, and Communications Segment

The NPOESS C3S should be designed to take maximum advantage of the experience that the NOAA and DOD operators have with respect to the operation of the current POES and DMSP satellite control systems. NPOESS should have standardized communications protocols to the maximum extent possible to ensure interoperability between the military Services, DoD and civil communities, and allied systems.

TRD3.7.2-1
The NPOESS C3S shall provide all functions required for day-to-day state of health monitoring and commanding of all operating spacecraft and to support the delivery of data to the Centrals. As a goal, the C3S and the IDPS

components at centrals should adhere to a common system architecture with common system software and, if applicable, common hardware.

TRD3.7.2-2
The C3S shall survive exposure to the natural environmental conditions of the local climate.

3.7.2.1 Satellite Operations Center

The primary SOC and the backup SOC should be compatible with existing military standards and civil protocols to ensure seamless transition during backup operations, continuity of data flow and processing, and ease of maintenance.

TRD3.7.2.1-1
The primary SOC shall be capable of performing the operational functions of satellite command and control, mission planning, antenna resource scheduling, launch and early orbit, anomaly resolution, data access, and the delivery of data to Centrals for the entire NPOESS constellation.

TRD3.7.2.1-2
The backup SOC shall be capable of performing the same operational functions as the primary SOC, with the exception that launch and early orbit operations will only be done from the primary SOC.

TRD3.7.2.1-3
The hardware and software located at the primary and backup SOCs shall be functionally identical and operated and maintained using the same commands and procedures.

TRD3.7.2.1-4
The planning function shall be designed to enable real-time adjustments to scheduled satellite usage.

TRD3.7.2.1-5
An operational data base shall be implemented for operations staff to maintain, track, and report system status.

3.7.2.2 Environmental Support

Environmental data, analyses, alerts, advisories, and forecasts are required to support mission operations, satellite mission planning, launch support, satellite tracking, real-time decision making, anomaly resolution, and other operational activities. These items are invaluable for the protection of resources and assets. In addition, spacecraft operators use these data to account and correct for drag errors, bearing and range errors, and a variety of satellite anomalies, including spacecraft charging, single event upsets, and satellite disorientation. Communications personnel use these data to compensate for signal loss due to ionospheric absorption; for signal amplitude and/or phase variation caused by scintillation and scattering; and radio frequency interference caused by solar radio frequency bursts.

TRD3.7.2.2-1
NPOESS shall use available space, near-earth, and terrestrial environmental data products in order to perform its mission.

3.7.2.3 Data Routing and Retrieval (DRR) Element

TRD3.7.2.3-1
The DRR element shall provide all inter-element communications for the C3S and the IDPS which includes the routing (from ingest at the ground stations) of both stored mission data and telemetry, and real-time telemetry to the SOCs and stored mission data to the IDPS Central element.

TRD3.7.2.3-2
The DRR element shall provide routing for commands, mission planning requests, and any other communications between the SOC, ground stations, FVS Element, IDPS central element, and external interfaces.

3.7.2.4 Ground stations Element

TRD3.7.2.4-1
The C3S shall use NOAA's CDAs at Fairbanks, Alaska and Wallops Island, Virginia, AFSCN RTSs, METOP ground stations such as Kiruna, Sweden or Tromso, Norway and/or commercial command data acquisition stations as needed to meet the data availability requirements.

TRD3.7.2.4-2
A backup capability shall exist such that all NPOESS requirements for the normal operational mode can be met without augmentation from METOP ground stations. Similarly, other C3 architectures may be evaluated, such as TDRSS.

3.7.2.5 Flight Vehicle Simulator Element

The FVS element will be able to use a FVS at the primary SOC, the backup SOC, and the satellite production facility.

TRD3.7.2.5-1
The FVS element shall be capable of simulating any of the on-orbit satellites. Interface equipment may be required to integrate spacecraft hardware to the FVS element.

TRD3.7.2.5-2
A control workstation shall be provided as part of each FVS to monitor and control the health and welfare of simulated satellites.

TRD3.7.2.5-3
The control workstation for the FVS element shall be capable of executing scenarios for training, emergency procedures, and flight and ground software test and certification.

TRD3.7.2.5-4
The FVS element shall be modular and provide for growth in functions and data throughput.

3.7.2.6 C3S Inter-Element Interface Requirements

TRD3.7.2.6-1
The SOC shall interface with the command data acquisition stations in the NPOESS ground station network to send the contents of the command uplink and receive the stored data and real-time telemetry downlinks.

TRD3.7.2.6-2
The DRR shall interface with the command data acquisition stationsin the NPOESS ground station network to receive the mission data streams from the stored mission data downlinks.

TRD3.7.2.6-3
The SOC shall interface with the FVS element to simulate sending commands to an NPOESS satellite and receiving responses back from an NPOESS satellite for operational and training purposes.

3.7.3 Interface Data Processor Segment

The IDPS will be comprised of Central and Field Terminal Elements.

TRD3.7.3-1
The IDPS shall earth locate all NPOESS sensors data in geodetic latitude and longitude corrected for altitude within the accuracy specified for each EDR in Appendix D, accounting for satellite position and attitude, sensor characteristics, earth geoid and other factors as required.

TRD3.7.3-2
The design of the IDPS element shall permit the use of ancillary data sources as required to generate the EDRs specified in Appendix E *(TBR).*

TRD3.7.3-3
Each IDPS element shall have a Data Base Management System (DBMS) to provide the users access to RDRs, SDRs, TDRs *(TBR),* and EDRs.

TRD3.7.3-4
The IDPS shall calibrate and correct the data, as appropriate to meet the interface specification requirements for data format.

3.7.3.1 IDPS Central Element

TRD3.7.3.1-1
Each IDPS Central element shall be capable of processing simultaneously downloaded mission data streams to meet RDR, SDR, and EDR timeliness requirements as appropriate.

TRD3.7.3.1-2
The IDPS shall be expandable up to one hundred percent growth in storage and processing capacity.

TRD3.7.3.1-3
The IDPS shall not overwrite the data in RDR/SDR/TDR~~/TDR~~/EDR fields for 24 hours *(TBR).*

3.7.3.1.1 IDPS for DoD Centrals (AFWA, 55SWXS, FNMOC, NAVOCEANO)

TRD3.7.3.1.1-1
The IDPS DBMS shall have adequate storage to store and have available for retrieval, the RDRs, SDRs, TDRs *(TBR),* and EDRs as specified in Appendix E for 24*(TBR)* hours of data per NPOESS satellite for *(TBS)* satellites.

TRD3.7.3.1.1-2
The IDPS shall process EDRs as specified in Appendix E within 20 minutes of receipt of satellite data (see para 3.2.1.2.1).

TRD3.7.3.1.1-3
The IDPS shall process the EDRs to the performance specification in Appendix D

3.7.3.1.2 IDPS for DoC Centrals (NOAA/NESDIS)

The IDPS at NOAA NESDIS is not required to process EDRs. Therefore, for the “DoC only” EDRs identified in Appendix D, operational code to process the EDR is not required; however, algorithm development is required to the extent necessary to validate that the RDR product is adequate to meet EDR performance specification.

TRD3.7.3.1.2-1
The IDPS DBMS shall have adequate storage capacity to allow access to the RDRs as specified in Appendix E for 24 hours of data per NPOESS satellite.

TRD3.7.3.1.2-2
The DBMS shall have adequate storage for *(TBS)* satellites.

3.7.3.2 Interface Data Processor Field Terminal Element

TRD3.7.3.2-1
The time to process EDRs as specified in Appendix E shall not exceed 20 minutes after loss of signal.

TRD3.7.3.2-2
The IDPS shall have imagery data, including SDRs, available for display within 2 minutes after receipt of data.

3.7.3.2.1 IDPS for High Data Rate Field Terminals

TRD3.7.3.2.1-1
The IDPS shall process the EDRs to the performance specification in Appendix D.

TRD3.7.3.2.1-2
Performance degradation due to lack of availability of ancillary data shall be documented.

TRD3.7.3.2.1-3
The IDPS shall contain enough on-line storage to store and have available for retrieval the RDRs, imagery SDRs*(TBR)*, and EDRs as specified in Appendix E for the last 24(TBR) hours. The IDPS may use compression techniques on all but the most recent pass to meet the storage requirement.

3.7.3.2.2 IDPS for Low Data Rate Field Terminals

TRD3.7.3.2.2-1
The IDPS shall process the EDRs to the performance specification in Appendix D.

TRD3.7.3.2.2-2
Performance degradation as a result of receiving the low data rate link (i.e. only a subset of the mission data), due to the use of lossy data compression, or lack of availability of ancillary data shall be documented.

TRD3.7.3.2.2-3
The low rate data terminal shall contain enough on-line storage to store four passes (*TBR*) of low data rate imagery.

TRD3.7.3.2.2-4
The low rate data terminal IDPS shall contain enough on-line storage to store and have available for retrieval the non-imagery derived RDRs, imagery SDRs *(TBR)* and EDRs as specified in Appendix E for the last 48*(TBR)* hours. The IDPS may use compression techniques on all but the most recent pass to meet the storage requirement.

3.7.4 Launch Support Segment

TRD3.7.4-1
The LSS shall have the capability to perform the required tests and operations necessary to successfully support the launch of an NPOESS satellite into orbit.

TRD3.7.4-2
The LSS shall provide access to the satellite for launch processing, servicing, and maintenance.

TRD3.7.4-3
The contractor shall develop LSS plans and procedures for pre-launch contingency operations.

TRD3.7.4-4
The LSS shall support post-launch operations at the launch base.

TRD3.7.4-5
The LSS shall support satellite command simulation and testing.

3.7.4.1 Ground Support Equipment (GSE)

TRD3.7.4.1-1
The LSS shall provide the necessary launch base Ground Support Equipment (GSE) and software for the completion of launch operations.

TRD3.7.4.1-2
The factory handling, carting, and LV mating equipment shall be designed for safe shipping, handling, and transportation of the satellite vehicle and associated equipment.

4. QUALITY ASSURANCE PROVISIONS

4.1 RESPONSIBILITY FOR INSPECTION

Unless otherwise specified in the contract the contractor is responsible for the performance of all inspection and test requirements specified herein. The government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

TRD4.1-1
The integrating contractor shall ensure that all subcontractors meet quality assurance requirements

4.1.1 Philosophy of Testing

The test requirements for the operational elements are separated into those applicable to space segment (satellite equipment) and those applicable to the C3, Interface Data Processor, and Launch Support segments. The specified tests provide general screening checks, but they are necessarily insufficient to assure absolutely the reliability of the system.

NPOESS will employ the following test strategy for the space segment: One flight unit will be subjected to protoqualification level testing, subsequent flight units will be acceptance level tested.

In addition, the non-space elements (C3 and IDP) of the System that are required to support operations should be adequately tested to assure satisfactory support of the space missions.

System developmental and acceptance testing will include a weather product test bed to demonstrate end to end system performance.

Finally, the pre-launch system-level tests and inspections are conducted to verify that each critical path in the launch system and in the on-orbit system is satisfactory.

4.1.2 Location of Testing

Tests and evaluations of the segment elements may be conducted at in-plant test facilities, which may include subcontractor's facilities and/or at a government-approved test facility. The part, material, and software unit development tests and evaluations, tests of ground equipment and of computer software also may be conducted at in-plant test facilities, which may include subcontractor's facilities or at a government-approved test bed.

TRD4.1.2-1
Where practical, integrated system tests of the IDPS and C3 ground equipment and computer software shall be performed on integrated CIs installed in an operational system. Whenever possible, these tests should be conducted at a specified target site with the support of the operational personnel. The weather product test bed sufficiently simulating the operational system capability for test purposes may be used for integrated system tests, if target sites, operational complexes, or other suitable operational support areas are not available.

TRD4.1.2-2
Prelaunch system-level inspections and tests shall be conducted on the operational system with the satellite mated with the launch vehicle, using operational interfaces to the extent practicable.

4.2 SPECIAL TESTS AND EXAMINATIONS

4.2.1 Inspections and Tests of the Space Segment

4.2.1.1 Satellite Parts, Materials, and Process Controls.

Parts, materials, and process controls are to be applied during production of all items to ensure that a reliable system is fabricated.

TRD4.2.1.1-1
During fabrication of the satellite and other space equipment, the tools and processes, as well as parts and materials, shall be adequately controlled and inspected to assure compliance with the approved manufacturing processes and controls.

4.2.1.1.1 Satellite Records

TRD4.2.1.1.1-1
Records documenting the status of the satellite and other space equipment shall be maintained following assignment of serial numbers.

TRD4.2.1.1.1-2
Each space item shall have inspection records and test records maintained by serial number to provide traceability from system usage to production lot data for the devices.

TRD4.2.1.1.1-3
Complete records shall be maintained for the space items.

TRD4.2.1.1.1-4
Complete records maintained for the space items shall be available for review during the service life of the System.

TRD4.2.1.1.1-5
The records shall indicate all relevant test data, all rework or modifications, and all installations and removals for whatever reason.

TRD4.2.1.1.1-6
Ground equipment items shall have inspection records and test records maintained by serial number for the service life of the item.

4.2.1.1.2 Satellite Manufacturing Screens

TRD4.2.1.1.2-1
Each critical subassembly, component, experiment, and satellite shall be subjected to in-process manufacturing and assembly screens and visual inspection IAW MIL-STD 1540C.

4.2.1.1.3 Nonconforming Material

TRD4.2.1.1.3-1
Non-conforming material or assembled units in each lot shall be reworked and re-screened in accordance with MIL-STD 1540C.

4.2.1.2 Satellite Design Verification Tests

TRD4.2.1.2-1
Design verification testing shall be performed to demonstrate compliance of new designs or of modified designs with the specified performance margins.

TRD4.2.1.2-2
Test units shall be sufficiently similar to the final production units so as not to invalidate the test results.

4.2.1.2.1 Engineering Testing

4.2.1.2.1.2 Developmental Testing

TRD4.2.1.2.1.2-1
Development testing shall be conducted in accordance with MIL-STD-1540C.

4.2.1.3 Protoqualification Testing

A comprehensive sensor test program, conducted in conjunction with the spacecraft test program, will demonstrate that the sensor can meet its performance requirements and will ensure that all interface requirements are satisfied. These interface requirements will include interface structural and thermal loads, electrical power, electrical signals and other interface performance characteristics for ground handling, launch, deployment (where applicable), and on-orbit operations as well as for worst case systems tests conducted after delivery to the spacecraft contractor. All of these tests will be conducted by the sensor contractor before delivery of the instruments to the spacecraft contractor.

Additional tests will be conducted at the satellite level after integration of the sensor onto the spacecraft. The types of testing to be performed by the spacecraft contractor include:

- Thermal vacuum and thermal cycling
- EMI/EMC characterization to understand and measure radiative and conductive emissions and susceptibility
- Static and Dynamic structural testing (including pressure vessel and ordnance testing)
- Electrical and Mechanical functional testing to demonstrate performance
- Calibration: Radiometric and Geometric

4.2.1.3.1 Component Level

TRD4.2.1.3.1-1
Except as specified herein, the first article manufactured of each type shall be protoqual or qualification tested in accordance with the component level tests in MIL-STD-1540C. The 3 dB, 5° C, or other design factors of safety or margins that are included in the design requirements specified herein include test condition tolerances that are those allowed in MIL-STD-1540C. When the actual test tolerances are less than those specified in MIL-STD-1540C, the qualification test levels may be reduced appropriately in accordance with provisions specified in MIL-STD-1540C.

TRD4.2.1.3.1-2
All protoqual tests shall be conducted with hardware of the final design that have passed the in-process production screens.

4.2.1.3.1.1 Requalification of Existing Designs

Requalification is required for items that incorporate extensive changes in design, manufacturing processing, environmental levels, or performance requirements. However, methodology presented in MIL-HDBK-340 may be used to show that existing designs, or items previously qualified for other applications, have adequately demonstrated compliance to all qualification requirements for the new designs. Deficiencies in meeting some requirements may be fulfilled by supplementing existing data with new test data.

TRD4.2.1.3.1.1-1
Qualification by similarity shall be permitted only with the concurrence of the contracting officer. Waiver of qualification or requalification requirements requires the approval of the contracting officer.

4.2.1.3.2 Satellite Level Protoqualification Tests

TRD4.2.1.3.2-1
Protoqual tests shall be performed to demonstrate, to the extent it is practical, that satellites that are manufactured in accordance with the approved processes and controls meet the specified design requirements.

TRD4.2.1.3.2-2
Except as specified herein, the first vehicle manufactured shall be protoqual tested in accordance with the vehicle level tests in MIL-STD-1540C. The 3-dB, 5° C, or other design factors of safety or margins that are included in the design requirements specified herein include test condition tolerances that are those allowed in MIL-STD-1540C. When the actual test tolerances are less than those specified in MIL-STD-1540, the protoqual test levels may be reduced appropriately in accordance with provisions specified in MIL-STD-1540C.

TRD4.2.1.3.2-3
All protoqual tests shall be conducted with hardware of the final design that have passed the in-process production screens.

4.2.1.4 Acceptance Tests

TRD4.2.1.4-1
Acceptance tests shall be performed as the basis for acceptance of items manufactured. Acceptance tests, including lot certification testing, is that testing performed to demonstrate confidence that production devices that have passed the in-process production screening also meet the other requirements specified.

4.2.1.4.1 Component Level Acceptance Tests

TRD4.2.1.4.1-1
Except as specified herein, space components shall be acceptance tested in accordance with the component level tests in MIL-STD-1540C.

TRD4.2.1.4.1-2
For space components that cannot be tested adequately after assembly and must rely upon the process controls and in-process production screening to assure satisfactory performance and reliability, appropriate lot certification tests shall be imposed.

4.2.1.4.2 Lot Certification Tests

TRD4.2.1.4.2-1
Space parts, materials, and components that cannot be tested adequately after assembly, and must rely upon the process controls and in-process screening to assure satisfactory performance and reliability, shall have appropriate lot certification tests imposed prior to assembly.

4.2.1.4.3 Space Segment Level Acceptance Tests

TRD4.2.1.1.4.3-1
Except as specified herein, satellite acceptance testing shall be in accordance with the vehicle level tests in MIL-STD-1540C.

4.2.1.5 Space Segment Service Life Verification Tests.

Service life verification tests are defined as those tests conducted on limited life devices to demonstrate that production devices will perform satisfactorily during their specified service life.

TRD4.2.1.5-1
Explosive ordnance devices and other components whose performance may degrade with time shall have life extensions based upon passing either an aging surveillance test or an accelerated aging test.

4.2.1.2 Inspections and Tests of Space Segment Ground Equipment and Computer Software

TRD4.2.1.2-1
Functional testing of ground equipment CIs and major components shall be conducted to demonstrate compliance with the specified requirements.

4.2.1.2.1 Part and Material Level Development Tests and Evaluations

TRD4.2.1.2.1-1
Part and material development tests and evaluations shall be conducted as required to qualify parts, materials, and processes to assure proper application in the design, to assure adequate performance margins, and to develop acceptance criteria for the items to avoid assembling defective hardware components.

4.2.1.2.2 Subassembly Level Development Tests and In-process Tests and Inspections

TRD4.2.1.2.2-1
Subassemblies shall be subjected to development tests and evaluations as may be required to demonstrate feasibility, to minimize design risk, and to assess the design and manufacturing alternatives and tradeoffs required to best achieve the development objectives.

TRD4.2.1.2.2-2
Tests shall be conducted as required to develop in-process manufacturing tests, inspections, and acceptance criteria for the items to avoid assembling defective hardware items.

4.2.1.2.2.1 Single Configuration Item (CI) Compliance Tests

4.2.1.2.2.1.1 Hardware CI Qualification.

TRD4.2.1.2.2.1.1-1
Each HWCI type shall be formally qualified to verify compliance with design or specified requirements.

TRD4.2.1.2.2.1.1-2
The qualification tests shall verify that the CI meets the specified system design requirements allocated to the CI, including external interfaces.

TRD4.2.1.2.2.1.1-3
The qualification tests shall verify the performance margins by evaluating the functional performance of the CI in an environment that simulates the operational environments associated with the CI.

4.2.1.2.2.1.2 Hardware CI Acceptance

The qualification tests on the first production item of each type serve as the acceptance test for that item.

TRD4.2.1.2.2.1.2-1
Subsequent production items of each type shall be formally acceptance tested as required. The acceptance tests of the subsequent production items may be a subset of the qualification tests.

4.2.1.2.2.1.3 Computer Software CI Qualification

TRD4.2.1.2.2.1.3-1
Formal qualification tests shall be conducted on each CSCI to verify CSCI compliance with design or specified requirements, i.e., stressing the CSCIs to the limits of specified requirements such as EIA/IEEE J-STD-016. In addition, formal acceptance procedures shall be used on each CSCI to ensure all criteria for reuse are met, according to the guidelines in Guidance for Software Reuse for the NPOESS Program *(TBS)*.

4.2.1.2.2.2 Combined CI Compliance Tests

TRD4.2.1.2.2.2-1
A series of compliance tests shall be conducted on expanding strings of CIs.

TRD4.2.1.2.2.2-2
The tests shall be designed to confirm functional compatibility among the mechanical, electrical, and computer software interfaces.

TRD4.2.1.2.2.2-3
Tests shall demonstrate that the end item functions resulting at each test sequence of combined CIs meet the performance requirements and system specifications.

4.2.1.2.2.3 Commercial Off-the-shelf or Government-Furnished Equipment Testing

Commercial off-the-shelf (COTS) items that are not developed specifically for acquisition or modification often are included in the System design. Also, GFE may be included in the System design. The COTS or GFE items may be either hardware, software, or a combination of the two.

TRD4.2.1.2.2.3-1
If incorporated in the System design, the COTS and GFE testing shall be included in the testing baseline, that is, as incorporated in the configuration tested for compliance.

4.2.2.1.2 Alignment Checks

TRD4.2.2.1.2-1
Alignment checks shall be conducted as required to verify alignments of specific equipment.

4.2.2.1.3 Integrated Space Segment Tests

Integrated System tests are satellite system-level functional tests conducted in accordance with the applicable paragraphs of MIL-STD-1540C.

TRD4.2.2.1.3-1
Integrated Satellite System tests shall include a flight simulation encompassing prelaunch, launch, and orbital modes of operation.

4.2.2.1.4 Mass Properties

TRD4.2.2.1.4-1
Actual weight, moment of inertia, and center-of-gravity (cg) measurements shall be made at the CI level, for sensors, and at the S/C subsystem level to verify predictions and to ensure that the installed equipment meets final weight, moment of inertia, and cg requirements.

4.2.2.1.5 Propulsion Subsystem Leakage and Functional Tests

TRD4.2.2.1.5-1
Functional tests of the vehicle propulsion subsystem(s) shall be conducted IAW MIL-STD 1540C.

4.2.2.1.6 External/Built-in Testing

TRD4.2.2.1.6-1
The sensor suite shall have the capability of being externally tested, while in storage and on the launch pad, to verify its performance and operational readiness. The space vehicle will support this capability.

4.2.2 Inspections and Tests of the C3 Segment

4.2.2.1 Integration and Acceptance Tests

TRD4.2.2.1-1
On-site tests of the NPOESS C3 Ground Equipment shall be required for system acceptance.

TRD4.2.2.1-2
Integration and Acceptance tests of NPOESS C3 Ground Equipment hardware and software shall be conducted after installation of equipment at the SOCs and, if applicable, CDA and AFSCN stations. These tests will be conducted in accordance with contractor provided/USG approved test plans and procedures, using USG provided personnel in operational capacities.

TRD4.2.2.1-3
Tests shall parallel live operations and may use live, recorded, or simulated telemetry inputs, as appropriate.

TRD4.2.2.1-4
Tests shall be designed to ensure no loss of operational data and shall result in no impact to ongoing operations.

TRD4.2.2.1-5
Test plans shall incorporate procedures to disengage the test system in order to reestablish operational integrity.

4.2.2.2 C3 Computer Software CI Qualification

TRD4.2.2.2-1
Formal qualification tests shall be conducted on each CSCI to verify CSCI compliance with design or specified requirements, i.e., stressing the CSCIs to the limits of specified requirements such as EIA/IEEE J-STD-016. In addition, formal acceptance procedures shall be used on each CSCI to ensure all criteria for reuse are met, according to the guidelines in Guidance for Software Reuse for the NPOESS Program *(TBS).*

4.2.2.2.1 Combined CI Compliance Tests

TRD4.2.2.2.1-1
A series of compliance tests shall be conducted on expanding strings of CIs.

TRD4.2.2.2.1-2
The tests shall be designed to confirm functional compatibility among the mechanical, electrical, and computer software interfaces.

TRD4.2.2.2.1-3
Tests shall demonstrate that the end item functions resulting at each test sequence of combined CIs meet the performance requirements and system specifications.

4.2.2.3 Commercial Off-the-shelf or Government-Furnished Equipment Testing

Commercial off-the-shelf (COTS) items that are not developed specifically for acquisition or modification often are included in the segment design. Also, GFE may be included in the segment design. The COTS or GFE items may be hardware, software, or a combination of the two.

TRD4.2.2.3-1
If incorporated in the System design, the COTS and GFE testing shall be included in the testing baseline, that is, as incorporated in the configuration tested for compliance.

4.2.3 Inspections and Tests of the IDP Segment

4.2.3.1 Integration and Acceptance Tests

TRD4.2.3.1-1
On-site tests of the IDPS system shall be conducted at Centrals and at selected field terminals for system acceptance.

TRD4.2.3.1-2
Integration and Acceptance tests of all IDP hardware and software shall be conducted after installation of equipment at the Centrals and, if applicable, at selected field terminals.

TRD4.2.3.1-3
These tests shall be conducted in accordance with contractor provided/USG approved test plans and procedures, using USG provided personnel in operational capacities.

TRD4.2.3.1-4
Tests shall parallel live operations and may use live, recorded, or simulated input, as appropriate.

TRD4.2.3.1-5
Tests shall be designed to ensure no loss of operational data and shall result in no impact to ongoing operations.

TRD4.2.3.1-6
Test plans shall incorporate procedures to disengage the test system in order to reestablish operational integrity.

4.2.3.2 IDPS Computer Software CI Qualification

TRD4.2.3.2-1
Formal qualification tests shall be conducted on each CSCI to verify CSCI compliance with design or specified requirements, i.e., stressing the CSCIs to the limits of specified requirements such as EIA/IEEE J-STD-016. In addition, formal acceptance procedures shall be used on each CSCI to ensure all criteria for reuse are met, according to the guidelines in Guidance for Software Reuse for the NPOESS Program *(TBS).*

4.2.3.2.1 Combined CI Compliance Tests

TRD4.2.3.2.1-1
A series of compliance tests shall be conducted on expanding strings of CIs.

TRD4.2.3.2.1-2
The tests shall be designed to confirm functional compatibility among the mechanical, electrical, and computer software interfaces.

TRD4.2.3.2.1-3
Tests shall demonstrate that the end item functions resulting at each test sequence of combined CIs meet the performance requirements and system specifications.

4.2.3.3 Commercial Off-the-shelf or Government-Furnished Equipment Testing

Commercial off-the-shelf (COTS) items that are not developed specifically for acquisition or modification often are included in the segment design. Also, GFE may be included in the segment design. The COTS or GFE items may be hardware, software, or a combination of the two.

TRD4.2.3.3-1
If incorporated in the Segment design, the COTS and GFE testing shall be included in the testing baseline, that is, as incorporated in the configuration tested for compliance.

4.2.4 Inspections and Tests of the Launch Support Segment

4.2.4.1 Launch System Prelaunch Validation Tests

TRD4.2.4.1-1
Pre-launch validation tests shall be conducted on the launch vehicle in accordance with the applicable requirements. These integrated System tests include all tests designed to verify System and launch conductor performance.

4.2.4.2 Prelaunch Validation Tests

TRD4.2.4.2-1
Pre-launch validation tests shall be conducted on space equipment in accordance with the applicable requirements of MIL-STD-1540C for all operational satellites to assure that there are no out-of-tolerance conditions or anomalous behavior.

TRD4.2.4.2-2
The satellite shall be operated through a simulated sequence of ascent phase, separation and engine ignition phase, orbital injection, on-orbit operation and, if applicable, recovery phase.

TRD4.2.4.2-3
Whether electrical, mechanical, or both, all critical paths or circuits shall be verified from the application of the initiating signal through completion of each event. This testing is intended to verify that an event command or signal was generated properly and sent on time, that it arrived at its correct destination, that no other function was performed, and that the signal was not present other than when programmed. Once successfully accomplished, that particular critical path or circuit is considered validated. Not all end-to-end tests can be performed with only flight hardware, as in the case in which an explosive event is involved. In cases in which end-to-end testing cannot be performed with the flight hardware and software, appropriate simulation devices should be used to exercise the flight hardware and software to the maximum extent possible. Simulation devices should be controlled carefully and should be permitted only when there is no feasible alternative for conducting the test. All of the events that occur during the mission profile should be tested in the flight sequence to the extent that is practical. Redundant components and subsystems also should be validated in the same manner.

4.2.4.3 Certification for Flight

Upon completion of the integrated launch system tests, the test history of the integrated equipment will be reviewed to determine its acceptability for flight. The concept of product flight accreditation is used to assure that the critical components satisfy all requirements that have been found necessary for successful space missions. Unless specifically excluded, flight accreditation should incorporate all technical assessment activity from inception of the program through manufacturing, qualification, transportation, handling, storage, and post-delivery operations leading to final installation and checkout prior to flight. The assessment activity involves incremental reviews and culminates in documentation that all accreditation requirements have been met. After completion of the final review for each item, the acceptability or non-acceptability for flight is documented.

4.2.5 Integrated System Level Testing

TRD4.2.5-1
Integrated System tests shall be designed to exercise, as near as practical and possible, the total System.

TRD4.2.5-2
Where practicable, integrated System tests shall be performed on integrated CIs installed in an operational System.

TRD4.2.5-3
The integrated System tests shall incorporate tests of the affected interfaces of the ground equipment and software with other elements of the operational System.

TRD4.2.5-4
The integrated tests shall be structured as appropriate to demonstrate design requirements of the System related to such items as performance, electromagnetic compatibility, reliability, maintainability, system safety (hazardous noise, radiation hazards, pressure vessels), logistics supportability, operational procedures, and personnel performance.

TRD4.2.5-5
Tests shall be focused on the external interfaces involved, the use of operational databases and operational scenarios, and the System requirements from a mission operations perspective.

TRD4.2.5-6
The tests also shall include System safety tests, inspections, and evaluations in such areas as hardware inspections for electrical and mechanical hazard, including caution labeling; evaluation of the fire suppression system; evaluation of emergency systems; use of any hazardous materials; possibility of personnel exposure to any equipment and ambient noise levels considered hazardous; RF radiation testing to determine actual levels of radiation to which personnel may be exposed and to evaluate the accuracy of the mathematical predictions of radiation levels; proper functioning of any radiation warning systems; and proper procedures for inspection, operation, and maintenance of pressure vessels.

4.2.5.1 Weather Products Testbed

TRD4.2.5.1-1
End-to-end requirements validation shall be accomplished using an integrated weather products test bed.

TRD4.2.5.1-2
The integrating contractor shall provide to the IPO sufficient design-specific information and science algorithms to allow the IPO to accurately model the performance of the space vehicle design, including (TBR) parameters for each sensor.

TRD4.2.5.1-3
EDR requirements shall be validated by the contractor by analysis, modeling, and/or simulation based on the instrument design and performance characteristics and the contractor's scientific algorithms.

TRD4.2.5.1-4
All relevant sources of error, including those associated with the scene radiance, instrument, spacecraft, data transmission, and algorithms, shall be taken into account. The spacecraft contractor is to provide errors associated with spacecraft and data transmission.

TRD4.2.5.1-5
The contractor's analysis, modeling, and/or simulation shall be sufficiently extensive in scope to verify that EDR requirements are met under a broad range of conditions *(TBR)* that are representative of those occurring in nature, including both typical and extreme conditions. EDR requirements should be validated for any value of the geophysical parameter within the specified measurement range, any latitude, any time of day (subject to specified daytime or nighttime only restrictions), any season, any climate, any level of cloudiness (subject to specified clear/cloudy restrictions), any sensor viewing geometry, and any degree of horizontal or vertical spatial structure in the observed scene consistent with nature. This requirement may be satisfied by a judicious choice of typical and stressing test cases for analysis, modeling, and/or simulation, and should not be construed to entail exhaustive validation throughout the space of parameters and conditions mentioned in this paragraph.

TRD4.2.5.1-6
For simulations involving random variable generation, a sufficient number of iterations shall be performed for each test case or standard scene to ensure that statistical errors are negligible compared to the EDR attribute value being validated.

4.2.5.2 Data Bases

TRD4.2.5.2-1
The contractor shall include in his requirements flowdown analysis uncertainties in data from any data bases that are relied upon in generating EDRs.

TRD4.2.5.2-2
The contractor shall notify the government

1) If the contractor determines that these uncertainties prevent a threshold requirement from being met;

2) If reliance on the data base is deemed necessary by the contractor; and
3) If the data base varies in time, (that is, is updated in near-real-time), and is not under the control of the contractor.

The government will determine the appropriate remedial action.

TRD4.2.5.2-3
The contractor shall generate a new data base or partial data base if a fixed data base, (e.g., one addressing terrain) is needed, and existing data bases are not adequate to allow meeting EDR thresholds. The IDPS (TSPR) contractor will be responsible for developing any new fixed data bases needed by the operational algorithms.

TRD4.2.5.2-4
The contractor shall identify and quantify any EDR performance degradation resulting from the lack of availability of any data base or other ancillary data.

4.2.5.3 System Prelaunch Validation Tests

TRD4.2.5.3-1
Prior to launch, validation tests shall be conducted on the system (Space, C3 and IDP) in accordance with the applicable requirements. These integrated System tests include all tests designed to verify System and operator performance.

4.3 Operational Test and Evaluation

4.3.1 Initial Operational Test and Evaluation

Initial operational tests and evaluations (IOT&E) are conducted at the system level with the equipment in its operational configuration, in an operational environment, by the operating personnel or an independent test organization. These operational tests are conducted in an environment that is as operationally realistic as possible and practical in order to test and evaluate the effectiveness and suitability of the hardware and software in meeting operational requirements.

4.3.2 Full Operational Test and Evaluation

Full operational tests and evaluations (FOT&E) are conducted with the equipment in its operational location by the operating personnel or an independent test organization. These tests demonstrate and verify the continued capability of the System, with the modification or upgrade incorporated, to support ongoing missions. The FOT&E are conducted to refine estimates made during IOT&E and to identify operational System deficiencies.

4.4 VERIFICATION CROSS REFERENCE

4.4.1 Verification Methods

TRD4.4.1-1
Requirements of Sections 3 and 5 shall be verified by the methods specified for each requirement as shown in the Verification Cross Reference Matrix *(TBD)*.

TRD 4.4.1-2
Methods of verification shall be selected from the following:

a. Inspection. An observation or examination of the item against the applicable documentation to confirm compliance with requirements.

b. Analysis. A process used in lieu of or in addition to testing to verify compliance with specifications. The techniques typically include an interpretation or interpolation/extrapolation of analytical or empirical data under defined conditions or reasoning to show theoretical compliance with stated requirements.

c. Demonstration. An exhibition of the operability or supportability of an item under intended service-use conditions. These verifications are usually non-repetitive and are oriented almost exclusively toward acquisition of qualitative data. Demonstrations may be accomplished by computer simulation.

d. Test. An action by which the operability, supportability, performance capability or other specified qualities of an item are verified when subjected to controlled conditions that are real or simulated. These verifications may require use of special test equipment and instrumentation to obtain quantitative data for analysis as well as qualitative data derived from displays and indicators inherent in the item(s) for monitor and control.

e. Similarity. Similarity is the process of comparing a current item with a previous item, taking into consideration configuration, test data, application and/or environment. The evaluation should be documented and shall include: the test procedures/reports of the item to which similarity is claimed; a description of the difference(s) between the items; and the rationale for verification by similarity. All in orbit experience should be documented and available for review.

Not Applicable. Use of the term "Not Applicable" shall be limited to those paragraph/paragraph headings for which there is no method of verification or where verification is accomplished in subparagraphs.

5. PREPARATION FOR DELIVERY

5.1 PRESERVATION AND PACKAGING

TRD5.1-1
Deliverable items shall be packed and handled in such a manner as to protect them against vibrations, shocks, moisture, and contamination associated with ground or air transport.

TRD5.1-2
Protection shall be provided against natural environmental conditions using containers, shrouds, or covers.

TRD5.1-3
Access provisions for inspection and handling shall be incorporated for all deliverable items.

TRD5.1-4
A positive means to verify compliance with shock, temperature, and moisture requirements shall be included with all deliverable items.

5.2 MARKINGS

Deliverable units should be marked in accordance with MIL-STD-129M as appropriate for the item being prepared.

6. NOTES

6.1 INTENDED USE

The System is intended for use in the National Polar-orbiting Operational Environmental Satellite System to support worldwide DOD and civilian operations.

6.1.1 Threat

The threats to NPOESS are discussed in the following classified references: Space Systems Threat Environment Description (TED), S/NF/FRD, DOC NAIC-1571-727-95, 11 Sep 95, and the Defense Meteorological Satellite Program (DMSP) /National Polar-Orbiting Operational Satellite System (NPOESS) System Threat Assessment Report (STAR), Secret, NAIC-1571-0110-96, Mar 96. NPOESS survivability requirements are contained in the classified Appendix B of this document.

6.1.2 Operational Threat Environment

See DMSP/NPOESS STAR for details on countries that have the capability, or potential capability to threaten NPOESS.

6.1.3 System Specific Threats at Initial Operational Capability (IOC) and IOC+10 years

The most likely threats against NPOESS fall into four main categories. The first is Information Warfare (IW), which encompasses network vulnerabilities, Electronic Warfare (EW), and exoatmospheric nuclear bursts. The second is the threat from anti-satellite (ASAT) directed energy weapons (DEWs), to include lasers, radio frequency weapons, and neutral particle beam weapons. The third is the threat from ASAT kinetic energy weapons (KEWs). The fourth is the threat to NPOESS terminal control segments from conventional, unconventional, and non-military forces. See DMSP/NPOESS STAR for details.

6.1.4 Reactive Threat

The reactive threat is an assessment of changes to the threat environment that could reasonably be expected to occur as a direct result of the development and deployment of NPOESS. No reactive threats are anticipated. See DMSP/NPOESS STAR for an explanation.

APPENDIX A
DEFINITION/GLOSSARY OF TERMS

See the NPOESS MASTER GLOSSARY in the NPOESS Contactor's Library

APPENDIX B
SURVIVABILITY REQUIREMENTS

Appendix B is classified and will be available in hardcopy in the NPOESS contractor libraries located in Silver Spring and Los Angeles after contract award.

APPENDIX C
SENSOR/TEMPERATURE DATA RECORDS FOR IMAGERY (TBS)

APPENDIX D
ENVIRONMENTAL DATA RECORD CHARACTERISTICS

40.1 Reserved for System Level EDR requirements (a separate Word Document file)

APPENDIX E
NPOESS EDR/RDR MATRIX

50.1 NPOESS EDR/RDR Matrix.

R = RDRs and E = EDRs.

The real-time high data rate link will contain the following mission data *(TBR):*

a) High (regional) resolution visual and IR imagery (with content similar to the current DMSP fine mode and NOAA High Resolution Picture Transmission)

b) Other NPOESS sensor and associated sensor data needed by the HRD field terminals to meet the EDR processing requirements specified in Table E1.

c) Other (TBS) data

The real-time low data rate link will contain the following mission data *(TBR):*

a) A (TBS) subset of real-time visual, visual night and IR imagery (with content similar to the current NOAA Automatic Picture Transmission or future Low Resolution Picture Transmission or DMSP's real time data smooth mode)

b) Other NPOESS sensor and associated sensor data needed by the LDR field terminals to meet the EDR processing requirements specified in Table E1.

c) Other (TBS) data

The processing requirements for the Centrals, HRD and LRD processing sites are shown in 50.1 NPOESS EDR/RDR Matrix.

PARAMETER	DoD (NAVY)			DOC			DoD (AF/ARMY)			
	FNMOC	HRD Field	LRD Field	NESDIS	HRD Field	LRD Field	AFWA	55SWXS	HRD Field	LRD Field
KEY ENVIRONMENTAL PARAMETERS										
Atmospheric Vertical Moisture Profile	R/E	R/E		R	R	R	R/E		R/E	R/E
Atmospheric Vertical Temperature Profile	R/E	R/E		R	R	R	R/E		R/E	R/E
Imagery	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Sea Surface Temperature	R/E	R/E		R	R	R	R/E			R/E
Sea Surface Winds	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Soil Moisture	R/E	R/E		R	R	R	R/E		R/E	R/E
ATMOSPHERIC PARAMETERS										
Aerosol Optical Thickness	R/E	R/E	R/E	R			R/E		R/E	R/E
Aerosol Particle Size	R/E	R/E	R/E	R			R/E		R/E	R/E
Ozone Total Column/Profile				R						
Precipitable Water	R/E	R/E		R	R	R	R/E		R/E	R/E
Precipitation Type/Rate	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Pressure (surface/profile)	R/E	R/E	R/E	R			R/E		R/E	R/E
Suspended Matter	R/E	R/E	R/E	R			R/E		R/E	R/E
Total Water Content	R/E	R/E		R			R/E			R/E
CLOUD PARAMETERS										
Cloud Base Height	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Cloud Cover/Layers	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Cloud Effective Particle Size	R/E	R/E		R	R	R	R/E		R/E	R/E
Cloud Ice Water Path				R	R	R	R/E		R/E	R/E
Cloud Liquid Water	R/E	R/E		R	R	R	R/E		R/E	R/E
Cloud Optical Thickness	R/E	R/E		R	R	R	R/E		R/E	R/E
Cloud Top Height	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Cloud Top Pressure				R	R	R	R/E		R/E	R/E
Cloud Top Temperature	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
EARTH RADIATION BUDGET PARAMETERS										
Albedo (Surface)	R/E	R/E	R/E	R			R/E			
Downward Longwave Radiation (Surface)	R/E	R/E		R						
Downward Shortwave Radiation	R/E	R/E		R						
Absorbed Solar Radiation (TOA)	R/E			R						
Solar Irradiance	R/E			R						
Outgoing Longwave Radiation (TOA)	R/E			R						
LAND PARAMETERS										
Land Surface Temperature	R/E	R/E		R	R	R	R/E		R/E	R/E
Normalized Differential Vegetation Index (NDVI)				R	R	R				
Snow Cover/Depth	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E
Vegetation/Surface Type	R/E	R/E	R/E	R	R	R	R/E		R/E	R/E

PARAMETER	**DoD (NAVY)**			**DOC**			**DoD (AF/ARMY)**			
	FNMOC	HRD Field	LRD Field	NESDIS	HRD Field	LRD Field	AFWA	55SWXS	HRD Field	LRD Field
<u>OCEAN/WATER PARAMETERS</u>										
Currents	R/E	R/E	R/E	R						
Fresh Water Ice	R/E	R/E		R	R	R	R/E		R/E	R/E
Fresh Water Ice Motion	R/E	R/E		R	R	R				
Ice Surface Temperature	R/E	R/E		R	R	R	R/E			
Littoral Sediment Transport	R/E	R/E		R						
Net Heat Flux	R/E	R/E		R						
Ocean Color/Chlorophyll	R/E	R/E		R	R	R				
Ocean Wave Characteristics	R/E	R/E		R	R	R				
Sea Ice Age and Sea Ice Motion	R/E	R/E	R/E	R	R	R	R/E			
Sea Surface Height/Topography	R/E	R/E	R/E	R	R	R				
Surface Wind Stress	R/E	R/E		R	R	R				
Mass Loading	R/E	R/E	R/E	R						
<u>SPACE ENVIRONMENTAL PARAMETERS</u>										
Auroral Boundary				R				R/E		
Auroral Energy Deposition (Total)				R				R/E		
Auroral Imagery				R				R/E		
Electric Field				R				R/E		
Electron Density Profile/Ionospheric specification				R				R/E		
Geomagnetic Field	R/E	R/E	R/E	R				R/E		
In-Situ Ion Drift Velocity				R				R/E		
In-Situ Plasma Density				R				R/E		
In-Situ Plasma Fluctuations				R				R/E		
In-Situ Plasma Temperature				R				R/E		
Ionospheric Scintillation				R				R/E		
Neutral Density Profiles/Neutral Atmospheric Spec				R				R/E		
Radiation Belt and Low Energy Solar Particles	R/E			R				R/E		
Solar and Galactic Cosmic Ray Particles	R/E			R				R/E		
Solar EUV Flux				R				R/E		
Supra Thermal through Auroral Energy Particles				R				R/E		
Upper Atmospheric Airglow				R				R/E		
<u>OTHER PARAMETERS</u>										
Surface Data Collection				stored	real-time *(TBR)*					
Search and Rescue Data to be available at the 13 S&R Mission Control Centers and 25 S&R Local User Terminals (LUTs)										

APPENDIX F
ACRONYMS and ABBREVIATIONS

See the NPOESS Master Acronym List in the NPOESS Contractor's Library

APPENDIX G
POTENTIAL PRE-PLANNED PRODUCT IMPROVEMENTS

70.1 Potential Pre-planned Product Improvements

This paragraph describes elements of the NPOESS mission needs having potentially restrictive technical or programmatic uncertainties identified as a result of Phase 0 Concept studies. DOC and DoD maintain a need for these observations, and prioritize them in terms of mission criticality below. The NPOESS Demonstration/ Validation (Phase 1) allows for continued examination of possible solutions to these needs, including new or modified instrumentation in future space segments beyond NPOESS IOC. Candidate technologies for meeting these needs should be examined in NPOESS Phase 1 for possible inclusion at a later time. No thresholds are stated.

70.1.1 Tropospheric Winds (DOC/DoD)

Wind measured throughout the troposphere. Wind profile required for cloud returns and planetary boundary layer aerosol returns.

	Thresholds	Objectives
a. Vertical Coverage	N/A	surface to 20 km
b. Horizontal Cell Size	N/A	50 km
c. Vertical Sampling Interval	N/A	0.1 km
d. Mapping Uncertainty	N/A	10 km
e. Measurement Range	N/A	0-100 m/s
f. Measurement Precision	N/A	0.5 m/s, vector winds
g. Measurement Accuracy	N/A	1 m/s, horiz. components
h. Maximum Local Average Revisit Time	N/A	1 hour

70.1.2 Ozone Profile - High-Resolution (DOC)

Measurement of ozone concentration within a specified volume.

	Thresholds	Objectives
a. Vertical Coverage	N/A	*(TBD)*
b. Horizontal Cell Size (Profile)	N/A	250 km
c. Vertical Cell Size (Profile)		
1. 0-10 km	N/A	3 km
2. 10-25 km	N/A	1 km
3. 25-60 km	N/A	3 km
d. Mapping Uncertainty (Profile)	N/A	25 km
e. Measurement Range (Profile)		
1. 0-10 km	N/A	0.01-3 ppmv
2. 10-60 km	N/A	0.1-15 ppmv
f. Measurement Precision (Profile)		
1. 0-10 km	N/A	10 %
2. 10-15 km	N/A	3 %
3. 15-50 km	N/A	1 %
4. 50-60 km	N/A	3 %
g. Measurement Accuracy (Profile)		
1. 0-10 km: N/A	N/A	10 %
2. 10-15 km: 20 %	N/A	10 %
3. 15-60 km: 10 %	N/A	5 %
h. Maximum Local Average Revisit Time (Profile)	N/A	24 hours
i. Long Term Stability (Profile)	N/A	1 %

70.1.3 CH4 (Methane) Column (DOC)

Measure of amount of methane contained in a specified volume of air.

	Thresholds	Objectives
a. Vertical Coverage	N/A	Total column
b. Horizontal Cell Size	N/A	100 km
c. Mapping Uncertainty	N/A	25 km
d. Measurement Range	N/A	40-80 µmoles/cm2
e. Measurement Precision	N/A	1 %
f. Measurement Accuracy	N/A	5%
g. Maximum Local Average Revisit Time	N/A	24 hours

70.1.4 CO (Carbon Monoxide) Column (DOC)

Measure of carbon monoxide in a specified volume of air.

	Thresholds	Objectives
a. Vertical Coverage	N/A	Total column
b. Horizontal Cell Size	N/A	100 km
c. Mapping Uncertainty	N/A	25 km
d. Measurement Range	N/A	0 - 7 µmoles/cm2
e. Measurement Precision	N/A	3 %
f. Measurement Accuracy	N/A	5%
g. Maximum Local Average Revisit Time	N/A	24 hours

70.1.5 CO2 (Carbon Dioxide) Column (DOC)

Retrievals of column and total carbon dioxide, calibrated by the users with ground-based measurements, of stated precision needed to afford deduction of long-term variations and trends.

	Thresholds	Objectives
a. Vertical Coverage	N/A	Total column
b. Horizontal Cell Size	N/A	100 km
c. Mapping Uncertainty	N/A	25 km
d. Measurement Range	N/A	11,000 - 15,000 µmoles/cm2
e. Measurement Precision	N/A	15-20 µmoles/cm2
f. Measurement Accuracy	N/A	*(TBD)*
g. Maximum Local Average Revisit Time	N/A	24 hours

70.1.6 Optical Backgrounds (DoD)

Emissions are the result of interactions between precipitating energetic particles and solar ultraviolet radiation with neutral atmospheric constituents.

	Thresholds	Objectives
a. Coverage	N/A	Global
b. Horizontal Cell Size	N/A	10 km
c. Mapping Uncertainty	N/A	50 km
d. Measurement Range		
1. Wavelength	N/A N/A	1-29 microns, 0.4-0.7 microns, 0.04-0.2 microns
2. Brightness	N/A	*(TBD)*
e. Measurement Precision	N/A	*(TBD)*
f. Measurement Accuracy	N/A	*(TBD)*
g. Maximum Local Average Revisit Time	N/A	each orbit

70.1.7 Bathymetry (Deep Ocean and Near Shore) (DoD)

Vertical depth of water.

	Thresholds	Objectives
a. Vertical Coverage		
1. Deep Ocean	N/A	0-300 m
2. Near shore	N/A	0-200 m
b. Horizontal Cell Size		
1. Deep Ocean	N/A	300 m
2. Near shore	N/A	*(TBD)*
c. Vertical Cell Size	N/A	1 m
d. Mapping Uncertainty	N/A	10 m
e. Measurement Range		
1. Deep Ocean	N/A	0-300 m
2. Near shore	N/A	0-200 m
f. Measurement Accuracy	N/A	0.3 m
g. Maximum Local Average Revisit Time	N/A	*(TBD)*

70.1.8 Bioluminescence (DoD)

A measurement of the number of bioluminescent organisms present in sea water within a region.

	Thresholds	Objectives
a. Horizontal Cell Size	N/A	*(TBD)*
b. Mapping Uncertainty	N/A	*(TBD)*
c. Measurement Accuracy	N/A	*(TBD)*
d. Maximum Local Average Revisit Time	N/A	*(TBD)*

70.1.9 Salinity (DoD/DoC)

A measure of the quantity of dissolved materials in sea water. A formal definition is "the total amount of solid materials, in grams, contained in one kilogram of sea water, when all the carbonate has been converted to oxide, the bromine and iodine converted to chlorine, and all organic matter is completely oxidized. Units of measurement are parts per thousand, by weight."

	Thresholds	Objectives
a. Vertical Coverage	N/A	0-300 m
b. Horizontal Cell Size		
1. Global	N/A	20 km
2. Regional	N/A	0.25 km
c. Vertical Cell Size		
1. Global	N/A	10 m
2. Regional	N/A	2 m
d. Mapping Uncertainty		
1. Global	N/A	5 km
2. Regional	N/A	0.25 km
e. Measurement Range	N/A	0-40 ppt
f. Measurement Precision	N/A	0.1 ppt
g. Measurement Accuracy		
1. Global	N/A	*(TBD)*
2. Regional	N/A	0.5 ppt
h. Maximum Local Average Revisit Time	N/A	72 hours